UNITED STATES ARMY

JULY 1966

AVIATION DIGEST

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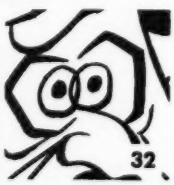

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The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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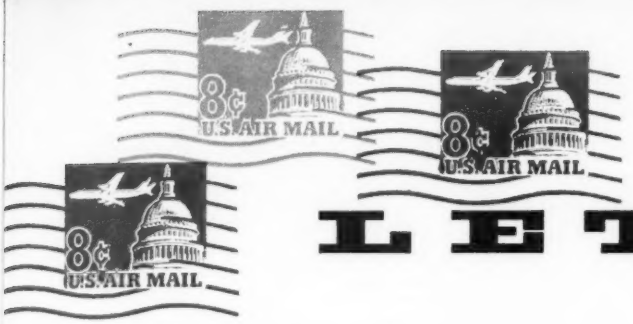


LETTERS

Sir:

In late July the "Buffalo Soldiers" of the 5th Squadron, 9th Cavalry will mark the 100th anniversary of the formation of the Regiment in 1866. The exact date of the celebration has not been set and will depend on mission requirements placed on the Squadron in July. Plans call for a review, military competitions, and a picnic, followed in the evening by Squadron festivities hosted by the officers and by the noncommissioned officers.

We wish to extend an invitation to any former members of any element of the Ninth Cavalry to be with us on this occasion. Persons who may be able to attend should write the Adjutant, 5th Squadron, 9th Cavalry, Fort Ord, Calif., 93941, for further information.

The Squadron would also be happy to receive any historical material, photographs, accoutrements, or other items pertaining to the Regiment for either temporary or permanent display.

LT COL VAN COURT WILKINS
Hqs, 5th Squadron, 9th Cavalry
Fort Ord, Calif., 93941

Sir:

One of the first Army aircraft to enter action in Vietnam was the "Low, Slow and Reliable" U-1A Otter. Until the Caribou appeared on the scene, the Otter was the Army's primary cargo airplane, and it functioned in a truly beautiful manner. The Otter carried anything and everything and performed practically every type mission possible. Hogs, chickens, machinery, fuel, ammunition, rations, mail, passengers and paratroopers—anything that would fit through the cargo doors was carried in the Otter. Not only did it serve as a combination cargo/troop transport, but it performed in a med-evac, reconnaissance, and flare delivery role. Around the clock, seven days a week, the Otter could be seen operating out of the shortest of unimproved strips or any one of the finer, permanent type airfields in Vietnam.

When the Caribou was first introduced to the Armed Forces in Vietnam, some folks thought the Otter would no longer be needed. However, the demand for services provided by the Otter still existed. Instead of phasing them out, their numbers increased, and a second Otter company was born.

Old, sick, tired and overworked, but, like the mighty Caribou, the Otter was doing a tremendous job. But *unlike* the Caribou the Otter was receiving little or no public recognition. Very soon now, the Army will lose the Caribou, but we will still have the Otter.

However, enemy action, an occasional accident, and normal wear and tear is bound to reduce the supply of Otters. This, coupled with the loss of our Caribou, is sure to create an unnecessary adverse condition for our troops in the field.

How do we prevent this?

Through its demonstrated diligent efforts, the Otter has more than proved its dependability and worthiness. Now a "big brother" Otter has come into being —the "Twin" Otter. If it's half as good as its predecessor, it's an outstanding piece of equipment. With it we can give the old Otter a well earned rest, fill the void created by loss of the Caribou, and continue giving our troops the support they deserve—the very best!

TWIN OTTER! Why not?

LT JAMES A. HOWD
Dept of Fixed Wing Tng
Ft Rucker, Ala., 36360

Sir:

We recently had the opportunity of seeing your excellent Aviation Digest, through courtesy of the U. S. Air Attache in New Zealand. As our Air Force operates Sioux and Iroquois helicopters we were particularly interested in articles dealing with these aircraft, and indeed anything appertaining to Flight Safety.

The U.S.A.F. and U.S.N. already send us their Flight Safety reviews but as we have only recently acquired helicopters on our inventory the need for flight safety material has not arisen where these aircraft are concerned.

May we please be put on your mailing list for four copies? Enclosed is a copy of our own magazine; if you would like to receive regular copies we should be pleased to place your department on our distribution list.

M. C. PREECE
Squadron Leader
Editor, RNZAF Flight Safety
Wellington, New Zealand

• *Exchange agreement on the way over.*—Ed

Sir:

A review of aircraft accident reports at Seventh Army Headquarters has revealed that some accident boards are confusing the use of the term "knowledge" with the terms "proficiency" and "judgment." An evaluation is in order to determine what is meant when a board's findings state that the accident was caused by an apparent lack of knowledge, proficiency, or judgment. A review of the meaning of each word is required so that each term can be placed in its proper perspective in an accident investigation.

Knowledge is acquired through study. It is an acquaintance with, or perception of, facts or truths. Thus, in applying this to our situation, a lack of knowledge stems from a lack of familiarity of flying information which is known or may be known.

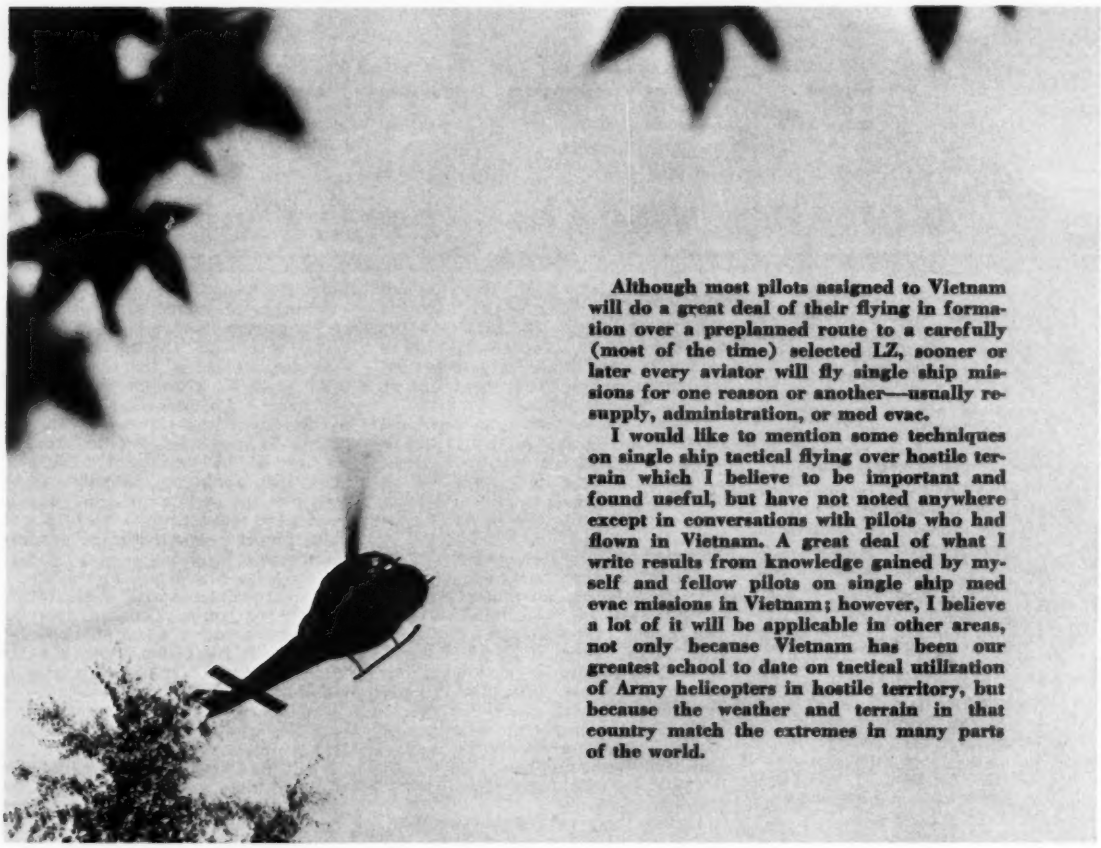
Proficiency, however, is synonymous with the words "skilled" or "expert." A lack of proficiency is indicative of a lack of skill, or lack of expertness in flying abilities, when applied to the aviator.

Judgment on the other hand is a mental conclusion made from evaluation of information available to the pilot. When poor judgment is used, it is caused by either a lack of information (knowledge) or by improper use of the information which was available to the pilot. One can say then that *proficiency is acquired through knowledge,* but only after the attainment of a certain level of skill.

Assume that we have equipped ourserves with the required knowledge and proficiency, and an unfavorable situation or emergency develops in the cockpit. Now the pilot makes a snap decision (judgment) based on immediately available mental information (knowledge). He puts his skill (proficiency) to work and comes out smelling like a hero. If any of these parts are missing, or the makeup of any one of the three is incomplete, we are faced with the inevitable accident.

MORAL: Become *knowledgeable* to increase your *proficiency* to the extent that when faced with unfavorable situations your *judgment* will be automatic and correct. This is less painful than a red faced confrontation with your buddies and your superiors after an accident.

MAJ JACK W. SERIG
7th Army, APO New York 09046



Although most pilots assigned to Vietnam will do a great deal of their flying in formation over a preplanned route to a carefully (most of the time) selected LZ, sooner or later every aviator will fly single ship missions for one reason or another—usually resupply, administration, or med evac.

I would like to mention some techniques on single ship tactical flying over hostile terrain which I believe to be important and found useful, but have not noted anywhere except in conversations with pilots who had flown in Vietnam. A great deal of what I write results from knowledge gained by myself and fellow pilots on single ship med evac missions in Vietnam; however, I believe a lot of it will be applicable in other areas, not only because Vietnam has been our greatest school to date on tactical utilization of Army helicopters in hostile territory, but because the weather and terrain in that country match the extremes in many parts of the world.

Solo Missions

Captain Patrick H. Brady

I STILL RECALL my first mission in Vietnam. It was a routine med evac to a village in the mountainous half of the Republic of Vietnam. I climbed in with a local short-timer and cranked up. I noted a slight raising of the eyebrows as I went through my flight school starting procedure, but he seemed well relaxed and despite the fact I departed sideways, never flinched. My pedal control improved and we headed for the pickup site.

As we neared our destination I

planned my traffic pattern, noting the wind and mentally setting up the various legs. My companion now became very alert, but I was confident he would stop twitching as he watched me progress through my carefully planned approach. To my astonishment he didn't. He was now looking at the stick like a lonely GI looks at the playmate of the month. His body was going through the same contortions as did my IP's during my first autorotations (and a few later ones).

He finally asked if I'd mind him showing me a combat approach to the area. Although my feelings were a little hurt, I consented. He then flew over the target, beeped it down a few hundred, and from 3,000 feet bottomed the pitch and dived for the area. Being fresh out of flight school (high recon, low recon, 500 fpm) you can imagine my surprise; but what surprised me more—we survived. His logic was simple: the only area we had any hopes of being secure was our LZ; therefore the shortest, fastest route in from altitude was the safest.

I found this theory pretty common and in some instances I concur. It is hard to dispute the fact that a fast moving, briefly exposed target is harder to hit than a slow, lengthily exposed one. But, even though each aviator should master the fast vertical approach, it is not the only combat approach and there are better ways into some areas.

The single most important factor in approaches into hostile areas is the terrain. With the proper reverence for wind, density altitude, load, etc., terrain should be the final determiner for direction and type of approach.

Give the enemy the benefit of any doubt during single ship missions

I am speaking of areas where the enemy disposition is unknown. Naturally, if the enemy is known to be west of your target, you would make the approach from the east and keep well to the east throughout the landing.

Unfortunately, our friends on the ground cannot always pinpoint the enemy, and you'll find that they sometimes have a disputable concept of what constitutes a secure area. A man who has had the enemy drooling on him all day is tickled to death to clear an area a few hundred yards in diameter. He often forgets that a helicopter might use 1/2 mile or more to get into an area—and is not 100 percent bulletproof. These factors coupled with a frequent lack of commo demand that the pilot use everything available to ensure a safe landing. Properly used terrain is your greatest benefactor.

If you follow this basic principle I believe it will be difficult to go wrong: put your eyes in the enemy's sockets. Study the terrain and use your imagination. Figure where you would be if you were the bad guys—or where you could be and what you could see if you were there. Always give the guy shooting at you the benefit of any doubts. Put him in the most favorable position with every possible advantage. Then analyze your chances of getting in.

You are most vulnerable at the bottom of your approach. No matter how fast you come in, you must round off at the bottom. You are a nice target during this uneasy period (you soon learn what pucker means). It is essential that you are not low and slow and in plain view of the enemy during that lonely period. A vertical fast approach will require a longer, more exposed flareout (varying with pilots) than if you come in on the deck. And it is easier to get back to altitude on a low, fast approach.

***Terrain can** be your greatest benefactor. It can hide you from the enemy on low approaches.*

Capt Brady is with the 54th Medical Detachment, Fort Benning, Ga.

Let's look at an example. Say your target is in wide-open terrain veined by canals lined with heavy vegetation (as in the delta region of the Republic of Vietnam). You spot your signal on the south edge of a treeline with open fields to the south and trees and vegetation to the north. Without ground communications you can be sure the enemy is north, so why spiral in? He can see you throughout a great deal of your approach. Why not fly south and lose your altitude over the open terrain then hustle in on the deck? The enemy won't even know you are there unless he is on the edge of the treeline, and then you still have some ground forces between you and him.

Besides the advantage of concealment and cover, you are able to keep up your airspeed until just before landing and eliminate the high roundout and the exposure that goes with it. Also if something should go wrong on the way in, it is easier to get back to altitude on the low, fast approach. Try to make a quick departure sometime when you are flaring out at the bottom of a steep approach. Coming in on the deck with good airspeed prevents that embarrassment.

Say your target is a clearing in some mountainous jungles (such as found throughout the northern part of the Republic of Vietnam). Study the terrain around your destination. Remember that it is as hard for the guy down there to see out as it is for you to see in. If there is high terrain to one side of your target, lose your altitude a good distance from it and come in on the trees. An OD helicopter on the trees is hard to see from above should the enemy be on the high terrain. If your target is on the highest terrain, then spiral in. If the jungle is level all around the target, go low-level if you are sure you can find it. If you've been in the trees, even in a clearing, and aircraft have flown over at low level you have probably noticed that your awareness of their presence was surprisingly short.

***In some cases** it's better to come in on the deck. The enemy won't know you're there and you'll have some ground forces between you and him*

What if your target is in a gully surrounded by high terrain and no one can tell you where the enemy is? Any way in is bad. In cases where you are in doubt it never hurts to make a low, fast pass and see if you draw fire. Some areas (an uncomfortable number) have no good approach. In these areas you should make the approach as if you were in the enemy's gunsights: fast and quick.

NIGHT APPROACHES

Single ship night missions require different techniques. Whereas in the day terrain was your greatest protector, at night it is the darkness. Take full advantage of it. If you are the only aircraft in the area turn your outside lights off. I'd also turn the console lights off. They are easy to spot close to the ground or in a bank. Although it seems that you can hear a helicopter sooner at night, it can almost land on top of you (blacked out) before you can see it. It is a strangely gratifying experience to see tracer fire missing you a mile at night.

Night approaches with landing lights are relatively simple, but if the enemy situation is such that you want to land without lights, things are more puckerish. Your rate of sink and airspeed must naturally be slower at night. The angle of approach should be relatively steep, depending on your knowledge of the area. The single most important factor in a blackout approach is teamwork within the crew: *use every eyeball in the aircraft.* This point cannot be overstressed.

I found the view through the windshield to be distorted, more so if it was covered with bulletproof plexiglass. The whole crew must be looking, watching, looking. The copilot should divide his attention between the instruments and a view out his side window. The crewmembers should be watching out their side doors to the flank and rear of the aircraft for enemy fire and obstacles as the aircraft nears the ground. The pilot too should take an occasional glance out his side window to check his position relative to the ground and the terrain under him.

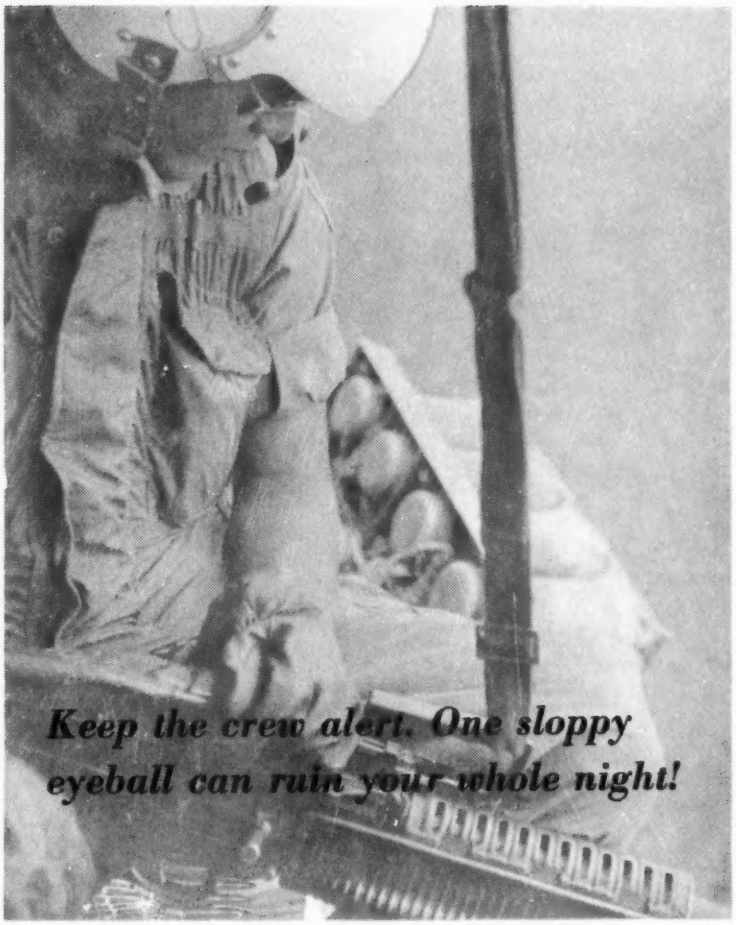
I found it best to keep my signal 90° to the nose of the aircraft

and make a wide circular approach, keeping my signal in sight at all times through the open window. This way you avoid the distraction and distortion found in looking over the instrument lights through the plexiglass. Throughout the approach each crewmember transmits only helpful information and clears the aircraft before it sets down.

If you have radio contact be sure to set a proper signal with the people on the ground. In their eagerness to help they often forget that flares or a spotlight blind the pilot. Flares are bad at night, especially when you are flaring out at the bottom of an approach. (I know of one ship that was saved by an *alert crew* who stopped the pilot from landing in a river, after he was blinded by a flare, and guided him to dry land.) If the ground people do not have regular military lights, which they seldom do, a flashlight with red lens provides a good signal in most terrain.

But never forget the crew. Their importance, especially at night, cannot be overstressed. Talk to them. Ask them questions, even if you know the answers. Keep them alert. Let them know you are counting on them to help you and that their keenness and attention are very important to the mission and the safety of the aircraft.

I am not alone when I say that I preferred to fly at night in Vietnam. Of course you are more limited by weather and terrain at night, but the enemy is not as much of a worry, nor are his bullets as accurate. A guy can pull his head out of his neck a little. Mission wise, many areas which are too hot in the daytime are readily accessible at night. However, you should never forget that the greatest hazard is from within the aircraft. One sloppy eyeball can ruin your whole night.



Army Aviation today is placing a great deal of emphasis on low level flying. It seems to me that it is often promulgated as THE way to fly in a tactical situation. Not a few aviators arrive in Vietnam with this notion firmly implanted in their thinking. Very few leave thinking that way. Certainly there is a place and a time for low level flying, but it is not every place and all the time. Our altitude should be governed by two factors: terrain and enemy capabilities.

If the enemy has a sophisticated weapons system (radar controlled), low level flight has many advantages in favorable terrain. In a conventional war if it were necessary to fly forward of the FEBA in a helicopter, over heavily wooded terrain, low level flight is certainly best. But such a flight over open terrain or rice paddies is suicide. You may be hidden from enemy radar but he could raise hell with any type of small arms—or a properly placed rock for that matter.

Regardless of the enemy weapons system, it is foolish to fly low level over open hostile terrain. Some think it the lesser of two evils because of the surprise factor. What is to prevent the enemy you have just surprised from calling ahead? The surprise is then

The author advises that in taking off from jungle clearings he found it best to get up just above the trees and stay there until he could get enough airspeed to do a fast cyclic climb.

on you. Mention low level flying to a pilot who has spent a year in the rice paddies south of Saigon —then run.

So far the Viet Cong do not have a sophisticated weapons system and a pilot in Vietnam (single ship mission) may choose his en route altitude as his own sense dictates. (Many use the sense of smell to determine proper altitude: when they can no longer smell because of a bleeding nose, they level off.) Low level flight reduces your reaction to an emergency, promotes pilot fatigue, and increases navigational problems; however, it can bring tactical advantage and reduce exposure. Each pilot should master low level techniques but no pilot should forget to apply good sound judgment on where and when to use it.

MISCELLANEOUS

When you land in an area it is wise to point the aircraft toward the direction of takeoff before setting down, but always face the aircraft away from the enemy. It's harder for that bullet to get to you if it has to go through the engine and transmission. In the daytime get airspeed before altitude on takeoffs; at night get the altitude first. In a jungle clearing get up on the trees and then stay there until you get some airspeed and can do a fast cyclic climb. If you climb straight out (especially with a load) it's slow going and you are a good target.

In flat terrain I found it easy to get a fast start if I picked up to a high (6 feet) hover and then dived it back on the deck. The faster you can gain that altitude the better. If there is a safe area nearby gain your altitude (and lose it) over that area. When you go into an isolated strip, especially at night, go in perpendicular to the landing axis. Snipers usually set up on the approach ends.

Experience, I believe, is a much abused commodity; often exaggerated by those who possess it and ignored by those who do not. It has been often and variously described, usually as our greatest teacher. However that may be, it does keep a dear school and while it may be our finest teacher, it could well be our last. I personally agree that experience is a wonderful teacher—someone else's experience.

But we should not seek in some experiences that which is not there, nor make the mistake of drawing universal conclusions from limited and circumstantial happenings. Mark Twain has warned that: "We should get out of an experience only the wisdom that is in it—and stop there; lest we be like the cat that sat on a hot stove lid. She will never sit down on a hot stove lid again—and that is well; but also she will never sit on a cold one anymore."

Because one man got burned during a certain maneuver does not rule out the use of that maneuver forever. Nor does the fact that another maneuver was successful prove that it is the only correct way. The many variables of a combat situation make stereotyped thinking dangerous. It is these variables that we should be aware of and how best to use them for survival. A new aviator will have to listen to a lot of advice based on a lot of experience. He should listen—then adopt that which makes most sense to him.

"Over hill, over dale, we have hit the dusty trail . . ."

Artillerymen have hit many dusty, rough trails and often wished for wings to cross a river, circumvent a mountain, or hurtle other obstacles. Now this possibility looms as the Army takes a close look at

Aerial Artillery

Major Keith J. Rynott

A JAPANESE prisoner of war, asked if American Artillery had had any effect on his surrender replied, "It influenced me considerably. It didn't make any difference whether I moved forward, to the rear, or remained stationary, the Artillery always followed. Day or night I had no rest or escape from it. The only way to avoid it was to surrender." —*Field Artillery Journal**

Artillerymen are proud of the above statement, especially since the wall of artillery fire is exactly what they set out to achieve in World War II. This statement and many more like it proved the effectiveness of American artillery in that war.

But that was some 22 years ago. Much has happened since that time to change the techniques of war. In World War II infantrymen were, for the most part, carried into the battle area in trucks and moved on foot in the extreme front. Artillery pieces, self-propelled or towed, had no trouble keeping up with them.

Now the Infantry has taken a giant leap forward. Many infantrymen are airlifted to the combat area and helicopters carry them within yards of the enemy. There is no front line as such. Airmobility is the concept of the day, and it would appear that artillery units that are restricted to ground transportation will not always be close enough to provide proper support, much less a wall of fire.

In January 1963 a study was started by the U. S. Army Artillery and Missile Center, Fort Sill, Okla., to study ways the Artillery could best meet the needs of the new fast-moving Infantry.

One of the simplest answers to the problem appeared to be some sort of aerial artillery. In simple terms this could be a combination of an artillery weapon and

*Downey, Fairfax. Sound of the Guns. New York: David McKay Company, Inc., 1956.

Maj Rynott was with the U. S. Army Artillery and Missile Center, Fort Sill, Okla., when this article was written. He is now serving in Vietnam.

an aerial carriage or platform. Such a combination would have the inherent ability of deception and surprise and be able to operate over extended distances without regard to terrain.

In addition the system should be capable of delivering direct fire from the air as well as direct and indirect fire from the ground; be able to move into an area, land, fire, and move out all in a matter of minutes; and be capable of delivering a large volume of fire in a very short time. In other words it should retain the traditional capabilities of artillery on the one hand and add airmobility and suppressive fire capabilities on the other hand.

Of course such a system would have its drawbacks. Some of these would be weather limitations, increased vulnerability, increased maintenance and logistical support, and increased cost over conventional artillery. In addition, to operate such a system local air superiority would be required.

To test such a unit a provisional aerial artillery battery was authorized by the U. S. Continental Army Command. UH-1Bs equipped with XM-3 (2.75 inch folding fin aerial rockets) were requested, but due to other priorities they were not available. Instead CH-34s, mounting ten 4.5 inch rocket tubes on each side, were furnished. Fifty thousand rounds of ammunition were allotted to the project.

To give the equipment an indirect fire capability, a panoramic telescope was mounted under the left cluster of tubes. Tube clusters were elevated manually to the desired quadrant elevation by using a common speed wrench of the type usually found in a mechanic's toolbox. Each cluster had to be elevated separately.

This first system, of course, had two serious disadvantages. Manual elevation with a hand wrench was slow and cumbersome. Having to elevate each cluster separately led to mistakes and took more time. These two disadvantages were eventually corrected by adding a power system of elevation and by running a torque tube through the body of the helicopter and attaching it to both tube clusters.

Since the rocket tubes cannot be traversed, it is necessary to move the entire helicopter to point the weapons in the desired direction. In the beginning this was accom lished by several husky cannoneers who, at the direction of the gunner, would move the tail of the aircraft in the direction wanted and chock it in position for firing.

This was time consuming, inaccurate, and required a large crew. To meet minimum requirements the traversing mechanism had to be powerdriven with a positive lockout device to prevent deflection during firing.

After trying several systems, a device called Robo-Tow was found to be satisfactory. The Robo-Tow is capable of moving the tail of the helicopter 6,400 mils at a rate of 14 mils per second through ditches 2 feet deep with slopes approximately 45°. It is installed by one cannoneer in approximately 90 seconds after the aircraft has landed.

The Robo-Tow and elevation system are both powered by an auxiliary power unit permanently installed inside the aircraft. All electrical wiring feeds through the fuselage of the helicopter and terminates at a control box in the vicinity of the panoramic telescope.

Rockets fire in pairs at 1 to 2 second intervals and are triggered electrically from the cockpit by the pilot.

First firings of the CH-34 and 4.5 inch rockets in the air-to-ground direct fire role at Fort Sill was in May 1963. When these firings proved satisfactory, it was decided to try ground-to-ground indirect fire. The first round in

When firing *rockets from ground positions, a device called the Robo-Tow is affixed to the rear wheel of the CH-34 to enable the gunner to move the aircraft left or right as needed*

this role was fired on 1 October 1963.

Testing of the system indicates that standard cannon fire direction procedures can be used. Numerous successful missions have been fired with Firing Tables 4.5-0-1. Impact registrations have yielded corrections which allow transfer to be fired well within firing table dispersion values. Normal fire for effect on transfer has been within 50 meters of the adjusting point, and all 20 rounds remained inside a 200 (deflection) by 500 (range) meter rectangle.

Although the CH-34 4.5 inch aerial artillery piece is not as accurate as cannon artillery and is not very good as a point target destructive weapon, it is capable of delivering large volumes of surprise area fire. One CH-34 with 4.5 inch rockets can deliver the same firepower as one volley of a battalion of 105 mm howitzers. When properly resupplied with ammunition, an aerial artillery battalion consisting of 12 helicopters with rockets can deliver a significant amount of timely fire support (240 rounds in less than 1 minute). And most important, these rounds can be delivered from positions and into target areas not normally accessible to ground bound artillery.

Organization of an aerial artillery unit can generally follow the well established pattern of other types of artillery. The CH-34 4.5 rocket battalion would have a headquarters and headquarters battery, three firing batteries, and a service battery with 505 officers and men and 47 aircraft.

Headquarters and headquarters battery would provide the normal command and control functions. It would have 9 forward observer sections and 3 liaison sections. The battery would have 23 officers, 5 warrant officers, 119 enlisted men, 2 CH-34s and 2 LOHs.

The three firing batteries would have four firing helicopters, each giving a total of fire equivalent of three 105 mm batteries. Each battery would have limited maintenance and supply and ammunition capability. Personnel in each would consist of 3 officers, 18 warrant officers and 57 enlisted men. There would be eight CH-34s and two LOHs per battery.

Service battery would perform all ground vehicle and aircraft maintenance as well as have the responsibility for ammunition and POL resupply. There would be 3 officers, 28 warrant officers, 93 enlisted men, and 13 CH-34 aircraft in the battery. These helicopters would be used mainly for resupply and maintenance.

The aerial artillery battalion would be 100 percent mobile with a combination of ground and air vehicles. The number of each may depend upon the unit it is to serve. For instance, if attached to a ROAD division, it may have more trucks and less aircraft than if it is to serve an airmobile type division.

Aerial artillery units should be considered for employment throughout the entire scope of land warfare, particularly when their use will provide a tactical advantage.

Aerial artillery's ability to displace rapidly over all types of terrain makes it particularly valuable when conventional weapons cannot be used. It can fill the current need for artillery in support of operations against irregular forces in an unsophisticated environment.

It may be assigned any of the tactical missions of the artillery or it may be attached to a supported force. It may even be held in reserve to ensure its availability at the time and place where it will have the greatest influence on the battle.

Flying artillery offers another capability to Artillery and a new use for Army Aviation

Aerial artillery is not intended to replace any existing weapons; rather it will be an additional capability of the Artillery arm and a new use for Army Aviation. The full potential of flying artillery is yet to be exploited and doctrine for its use has not yet been finished. Tactics for employment of aerial artillery will quite probably be similar to that used for cannon units, except that aerial artillery will enter the fray when it's impossible or impractical to employ ground artillery units.

The CH-34 and the 4.5 inch rocket are both considered obsolete and their use was only to prove the concept. Later model rockets and helicopters are yet to be fully tested. Requirements for a weapons system specifically designed to fulfill the aerial artillery functions are being studied by Department of the Army at the present time.

***One CH-34 delivers** the same firepower as a battalion of 105 mm howitzers*

The Romans assumed that Hannibal, the Carthaginian general, would not attempt to cross the Alps with his army. However, Hannibal moved through the pass of Mont Genevre and descended into the plains where he soon took control of almost all of Northern Italy. The Romans might not have fared so badly if someone had taken time to . . .

Challenge the Assumption

Lieutenant Colonel Milton P. Cherne

COLONEL, I'm relieving you of your assigned duties. I've carefully observed your performance during the past several months and determined that you are not qualified to satisfy the requirements imposed on you. Based on the data available to me, your length of service and past assignments, I assumed that you would be knowledgeable in the area of responsibility assigned to you. However . . ."

During the course of our daily activities we live in a world of assumptions. We assume the food we eat and the liquids we drink are clean and safe, that the teacher who guides our children is competent and the man who drives the bus is well trained. We assume our savings are secure and the commodities we purchase are reliable and meet specified standards.

Why can we safely make these assumptions?

We have grown secure in our knowledge that almost everything in our environment is checked, inspected and/or approved by some authoritative agency. Samples, tests, inspections, quality control, licenses and other prerequisites determine that we, the consumer and user, are protected. We assume that "they" are well trained, conscientious, dedicated and devoted in their never ending task of protecting us, the public.

Similarly, we of the military service assume that we are producing the finest quality personnel possible. We point with pride

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Lt Col Cherne is Secretary, General Staff, U.S. Army Aviation Center, Fort Rucker, Ala.

to statistics that show over 95 percent of our lieutenants are college graduates, 75 percent of all Army officers have degrees and many have pursued postgraduate work.

Our branch schools are the finest in the world, and each young officer entering onto active duty receives the benefit of experience from handpicked instructors. During the period between his basic and advanced course, we ASSUME he has the knowledge and ability to perform any mission or task commensurate with his training and rank. At some later date, this same officer is selected to attend additional advanced schooling. Again we ASSUME that he is prepared to accept this instruction and subsequently perform all tasks, for all men, in an outstanding manner.

One small segment of the Army challenged the assumption. This segment elected to insist that each individual prove to selected instructors his ability, capability and knowledge of his assigned tasks twice each year. That segment is the Army Aviator.

Regardless of rank, position or accumulated experience, each Army Aviator is required by regulation to successfully complete two separate and distinct examinations. Of equal importance, failure of either examination could result in the aviator's elimination from the program with attendant remarks in his personal files. Tests are not extremely difficult but they are comprehensive. The failure rate is minimal. The tests are designed to ensure that stated standards of currency are maintained. The examiner, or administrator of the test, assumes nothing! It is the responsibility of the general or the lieutenant to prove he has the necessary qualifications.

What are these tests? Could they be applied across the board to the entire office corps? What do we achieve by these tests?

The Army Aviator is required to successfully complete the Army Aviation Annual Written Examination, commonly referred to as the "writ," and an instrument flight examination conducted in the most complicated aircraft he is normally expected to fly. The flight examination is administered by a school trained examiner within 90 days preceding the examinee's birthday and the writ is administered at the end of each fiscal year.

First, let's study the requirements of the writ.

In January of each year, all Army Aviators receive a newly revised Study Guide. In effect, this could be called a practice test. The 1966 Study Guide contained a total of 150 questions. These questions were designed to probe the aviator's knowledge of regulations, weather, radio procedures, navigation under visual flight rules (VFR) or instrument flight rules (IFR), air traffic control (ATC) and terminal procedures.

In the Study Guide packet, excerpts of rules, regulations, navi-

***The assumption**—Plenty of fuel to get back to Saigon*
***The result**—"Lunch" with the VC*

gation charts, approach plates and sectional aeronautical charts are provided to allow the aviator to work the problems. In the back of the Study Guide is a list of correct answers with appropriate references. This format allows the aviator to work the problems with all necessary charts and maps and then check his answers with the list in the back of the Study Guide. If he nonconcurs with the answer provided him in the Study Guide, he need only research the paragraph, page and basic reference given for the problem.

It would not be unfair to say that most aviators are not abundantly happy over having to go through this drill annually, but most of them will begrudgingly admit that the Study Guide serves two distinct and valuable goals. First, it gives the aviator an insight as to what he can reasonably expect to encounter when he takes the writ. Second, it forces him to review changes in regulations, techniques, policies, procedures, and some of the basic principles of flying that are slowly forgotten over the years if not used frequently. It is adequate to say that Army Aviators enjoy a fine reputation throughout Federal Aviation Agency (FAA) circles and among other professional fliers.

Sometime during April, May or June, all aviators must take the writ. Each will take one of three versions and must successfully complete an examination. The test is composed of 50 questions and generally follows a situation-development type examination. It is an open book examination (years ago it was a closed book exam) and the aviator is allowed 4 hours to complete his work. This time is not excessive, as one problem may require the aviator to compute groundspeed, true airspeed, winddrift corrections, time en route and other integral problems associated with the final answer.

Once again, the point must be emphasized that the writ is only a vehicle to ensure that the aviator is doing his homework throughout the year and is, in effect, current with the changes that take place frequently. When he successfully completes the examination, it is safe to assume that he will not violate any major flight regulations. He is sufficiently knowledgeable to operate in weather conditions side-by-side with TWA, American Airlines, or anybody else.

The aviator's score card is graded by the examiner, and the flight records section is notified that he has successfully completed the writ. This fact is noted in his flight records. Score cards are then forwarded to Fort Rucker, Ala., and graded by machine. The number of correct and incorrect answers is analyzed; weak points on one year's examination can be stressed in next year's writ.

The aviator's second test is the flight examination. His examiner is MOS trained for this function and must pass judgment on the aviator's ability. AR 95-67 clearly states the minimum maneuvers the examinee must perform and the tolerances that must be adhered to. As a minimum, the aviator must demonstrate his ability to execute a takeoff without visual reference to the ground, recover from unusual attitudes, fly with single engine (multiengine aircraft), conduct an autorotation (helicopters only), and demonstrate a knowledge of various emergency procedures. He also must execute a minimum of two approaches to a facility and satisfy a host of other requirements.

At the termination of the ride he is given an oral examination to ensure that he can cope with a variety of situations and has a firm understanding of required subjects. If the examiner concludes that he is proficient and capable, he will reissue his instrument card and report his action to the Flight Examiners Board. Only then, can we ASSUME that he is fully qualified to perform his duties.

Other duties may permit the peak proficiency the aviator has obtained to fall off to some degree, but it will not fall below minimum standards. Each aviator knows that he must face another flight examination next year. He knows that these are standards directed by DA and if he desires to continue in the aviation program he must maintain his proficiency.

The requirement may motivate him to work and study during his normal off-duty time and to concentrate on his professional requirements when he would rather be playing golf or pursuing another sport.

Risky assumptions cannot be made in the field of aviation. Can the Army afford to make such assumptions in other fields?

It has been a common observation in recent years that the pace established for the young officer leaves little time for professional intellectual growth. Commanding a tactical or nontactical unit is a fulltime job, 24 hours a day. A staff job is demanding and has long hours; suspense dates and other frustrations are the rule rather than the exception. True, an officer is learning his trade first-hand from senior officers who are exceptionally well qualified to give him guidance and assist him in his growth. However, it is also true that they too are operating under pressure and accelerated time tables.

When does one take the time to study basic military sciences? The obvious answer is, of course, at the service schools. In 18 years of service, the average officer will have attended three schools, basic, advanced, and C&GS. Is this short slice of time adequate to ensure that the officer is well grounded, or must it be ASSUMED that he is?

The assumption—*This baby can take any thunderstorm*
The result—*A large electrical charge*

It is suggested that branch service schools determine what is important and mandatory for each officer to know or have a working knowledge of. Draft examinations on this material should be written by each service school and given to officers at random. These officers should then be critiqued and their responses used in preparing a final examination. The examination does not have to be graded; nor do the results have to be posted in the officer's personal records. But the test should give the individual officer an idea of what his branch feels is important for his growth and maturity; it should be a measuring stick he can use in comparing his growth with that of his contemporaries. *The examination must be, above all else, a motivating factor to direct the energies of the officer.*

Can it be assumed

- that each officer is reading the many fine books available to him in an effort to broaden his military knowledge?
- that each officer is familiar enough with the Uniform Code of Military Justice before he has reached the rank that will make him president of a court?
- that he is amassing the knowledge he will need to give guidance to junior officers serving under him?
- that he is as proficient as he should be?

We do know, that one segment has challenged the assumption, and the work, effort, research and studying that has supported the challenge has negated the question.

The assumption—*No sweat getting up and over the pass*
The result—*Rough day on the job*

SIOUX in a BAVARIAN STEW

Major Bak Y Chin

A VERITABLE postage stamp!" thought Lieutenant Smith as he picked out the only spot on the saddle of the mountain which looked level enough to set his skids down and made a pass over the selected landing site.

"Only this little stamp is suspended halfway between the bottoms of those billowy Cu's and the lush, green valley below. Pity those Navy jet jockeys!" his thoughts rambled on. "At least that stamp down there isn't bobbing like a cork in the ocean, though it isn't the smoothest up here either!"

"That's where I'm going to shoot a few approaches first," he said over the intercom to his passenger.

In the observer's seat of the Sioux was Specialist Jones, a photographer who had been out photographing the aviation section's training in mountain operations. He marvelled at how quickly after takeoff the base camp at Bad Tölz fell away and was lost among the many little villages and farms.

It was 0800 this day in September. The wind that whipped through the doorless bubble of the helicopter was still chilly, but September days were expected to be sizzlers in south Germany. In the morning sunlight the foothills of the Alps were jade green under clear, blue skies with hovering silvery, puffy clouds. Quiet Bavarian villages nestled in the valleys, clinging from mountain slopes at all angles, and studded the shores of shimmering resort lakes.

Through the bubble the purplish mountain peaks, which looked like gigantic picture windows when viewed at a distance, now loomed ahead like many towering, stony giants. The helicopter steadily pointed its skids up the valley and over the lower ridges toward the base of a sheer bluff.

"What a sight! Prima!" Specialist Jones was thinking when the sound of Lieutenant Smith's voice suddenly jarred him from his reverie. Looking down as he caught the words ". . . to shoot a few approaches, first," Jones glimpsed the saddle of the mountain sliding under the skids and the trees and rocks falling away to the valley below.

Turning to the pilot, Jones saw that Lieutenant Smith's attention was focused on the little saddle they had just flown over. He looked at the little irregular, grassy saddle spotted with brushes and boulders and wondered what the lieutenant was thinking behind that determined face and those serious eyes.

***The view through** the bubble is beautiful, but the mountains loom as treacherous, towering giants*

"That's the spot where the IP checked me out yesterday afternoon," Smith thought, as his mind continued to hum like an electronic computer:

"Let's see, it's only 1820 hours; the OAT is still 8° C, so the DA should still be plenty low. My engine and rotor blades should be pretty efficient for this altitude. . .

"I should be about 500 feet above the saddle; altimeter says 4,400 feet MSL, so the elevation must be—yes, it was about 3,900 feet MSL yesterday, as I recall. . .

"Pressure altitude reads 4,600 feet; that means I might not be able to hover—maybe. Better shoot to the ground. . .

"Better touch down near the rim of the saddle. If I can't hover, I can move the helicopter right up to the edge by hops*, like yesterday when the IP demonstrated it, and do a jump takeoff* over the edge. . .

"Have to make a go-around if it doesn't look like I'll hit the spot before I lose translation airspeed. Only approach is from either direction across the saddle. Make my final leg along the southwest branch of the ridge to ride the updrafts, if the wind is from the northeast. . .

"Not many forced landing areas. No place to go except the saddle or the bottom of the valley. . . .

Formerly with the Dept of Tactics, Fort Rucker, Ala., Maj Chin is presently serving in Europe.

*The OH-13 in high elevations is flown at 3200 rpm. The rpm can be pulled down from 3200 to 2700 to obtain a momentary hover and moved forward as in a "hop." The same technique is used to "jump" the helicopter over the end of pinnacles, clearing the tail rotor; then the nose and pitch is lowered to regain the lost rpm and flying airspeed.

The lieutenant jumped his helicopter over the ridge and allowed it to descend rapidly

Must make a steeper-than-normal approach since the saddle isn't very wide. If I'm short, it's possible there's a downdraft on the lee side of the saddle. . . ."

"Sir, how do you determine where the wind is coming from up here among the mountains?" Jones asked.

"It seems pretty difficult to determine that out here in the boondocks, doesn't it, Jones? Well, since the wind is affected by the ridges, valleys and peaks, the wind flowing over the top of the saddle can be from a completely different direction from that down at the end of the valley. But we use a technique of flight to find the best direction of landing.

"Jones, notice that the saddle runs generally from east to west up to that sheer precipice. That limits us to making our approach either to the south or to the north. To find which direction is better, I'll make two passes, one to the north and one to the south, about 20 feet above the saddle. We want to maintain the same indicated airspeed during each pass. The airspeed should be as slow as practicable above translation so we can judge the difference in the groundspeeds between the two passes. I'll use a 25 mph airspeed. The direction of flight giving us the slower groundspeed is the direction that is into the wind."

Lieutenant Smith turned onto his downwind leg, increased engine rpm to 3200, and made a slow pass to the north, then another to the south as he had described.

Pulling up and turning downwind again, he said, "Now, Jones, which direction gave us the slower groundspeed?"

"The first pass looked slower to me, sir," Jones replied. "That's a pretty neat technique, sir."

"It works," said the lieutenant as he continued onto base leg, swung onto final, lined up on a sight picture on the spot for an approach angle between that of a normal and a steep approach, and continued the descent right to touchdown. Maintaining 3200 rpm, he found it was still possible to hover, but it required almost maximum available power.

Lieutenant Smith was inspired by Specialist Jones' interest in the maneuvers, so he continued to explain: "In mountain operations the technique is to use the highest rpm which is safe for continuous operation. For the Sioux, 3200 rpm is used for all pattern and ground operation. Another extremely important consideration, Jones, is to determine your takeoff site and the path from the landing site to it over the ground. In elevations where the helicopter hasn't enough power to hover, a technique is used to move the helicopter by hops. I'll demonstrate this by hopping up to the rim of this saddle for a jump takeoff."

"In this case the path to the takeoff spot must be clear and smooth enough to set the helicopter down, won't it, Lieutenant?" Jones remarked.

"That's a very keen observation, Jones," Lieutenant Smith continued, "and when we get up here to the takeoff spot, we use another technique called the jump takeoff. Again I'll show you what it's like when I take off from this saddle."

Jumping the helicopter over the edge, Lieutenant Smith allowed it to descend rapidly with the slope of the terrain while regaining the rpm and safe airspeed. This caused Specialist

The lieutenant hops *his OH-13 to the rim of the saddle and demonstrates a jump takeoff*

***After his mind** checks off and analyzes the factors important to the proposed approach, the lieutenant makes a slow pass about 20 feet above the site*

Jones to remark, "In a situation like this, the selected takeoff spot must be right at a steep dropoff, won't it?"

"Absolutely."

"I didn't realize you had to plan all this before we landed," Jones said.

"Otherwise, we might have had to take a long walk back to base camp, Jones."

"You bet, sir," Jones agreed.

After the third landing on the little saddle, Lieutenant Smith looked up and said, "See that V-shaped crag on top of that bluff about a thousand feet above us, Jones? Let's see if we can land up there."

"I'm game, sir."

Climbing to about 500 feet above the top of the bluff, Lieutenant Smith made his high recon. He decided that he could land about 20 yards short of the V opening and then hop up to the ledge of the opening for a jump takeoff down the bluff. Once again his thoughts clicked off and analyzed the factors important to the proposed approach:

- Landing site—a little rocky, but touchdown area appears level.
- Takeoff site—the opening looks O.K. for a jump takeoff.
- Density altitude—should be about the same. OAT is 10° C.
- Site elevation—must be about 5,000 feet MSL, since the altimeter reads 5,500 feet in the pattern.
- Hover—probably not possible; must maintain 3200 rpm throughout the maneuver.
- Go-around point—again must initiate it before losing translation airspeed on short final.
- Flight pattern—north pattern to make use of possible updrafts of the north face of the bluff.
- Forced landing areas—it's a long drop to the valley floor if I can't make the landing site or the saddle.

He then made a slow pass about 20 feet above the site through the V to the west, then one out the V to the east, and said, "In which direction should we land to go into the wind, Jones?"

"It appeared we were going slower coming out of the bluff, sir," Jones answered.

Lieutenant Smith grinned. "O.K., that's the way we'll land then."

Making a north pattern, Lieutenant Smith turned on final in a northeasterly direction and continued on an approach a little steeper than normal into the confined area. At the termination of the approach, he realized that the landing area was actually not level enough to set both skids down. The engine rpm was being "milked" down gradually just

***Suddenly his vision** is obscured as billowy clouds flow into the opening just ahead*

trying to rest one skid on the ground, so it was necessary to reduce pitch and build the rpm up again and again.

After several minutes of looking around for a place to set the aircraft down firmly on the ground, Lieutenant Smith was still not too concerned about his predicament. He was relatively certain that he would be able to maneuver the helicopter up to the opening for a jump takeoff. Then suddenly, to his surprise, clouds began billowing up over the rocky opening before his eyes, obscuring his vision of the sides of the V.

Fearing that he might not be able to fly through the opening without danger of striking the sides, Lieutenant Smith looked to his left and behind to see if it were possible to take off to the north instead. He realized that the one factor he had failed to consider when he made his decision to land there had now precipitated a situation which was becoming more and more desperate with each minute of deliberation.

He could not hover; he could not set it down; he could not take off ahead. Scattered clouds at the top of the bluff were quickly spilling over and enveloping the trees behind him. Quickly assessing the situation, Lieutenant Smith decided he must get out of there without delay. The only takeoff possible was to his left over the now cloud-shrouded trees.

Checking for the 100th time to see that he still had 3200 rpm, he made a smooth, climbing turn to the left, applying maximum engine performance but keeping his climbout as shallow as possible. For several tense moments, as the helicopter climbed through the scattered clouds hugging the treetops and struggling to maintain a climb angle with the ascending tree line, Lieutenant Smith watched the rpm as it dropped steadily to 3000, then to 2900, then to 2750.

Suddenly they were clear of the clouds and trees, and the bright Bavarian sunshine once again lit up the bubble. With a sigh he quickly lowered the nose of the Sioux, reduced pitch, and dived the helicopter, following the descending terrain to regain his rpm and pick up cruise speed, while whispering a prayer of thanks.

Turning the Sioux to fly across the face of the bluff, Lieutenant Smith was not surprised to see a cloud bank capping the top of the bluff, obscuring completely the opening in the bluff. Over the intercom, he heard Specialist Jones say, "That was good flying, sir. But where did the clouds appear from?"

"That was a phenomenon common around mountain peaks," the lieutenant explained. ("And one which caught me napping and almost ruined my day," he thought without saying.) "The wind hitting the face of the bluff was forced up the sheer bluff. This phenomenon is called orographic lifting. The rising air cools as it is lifted. When it is cooled to the dew point temperature, the moisture in the air precipitates or condenses out as visible vapor, forming clouds. See where the base of the cloud is? That's where the rising air is cooled to the dew point temperature. That's why the whole top is getting clouded over. The wind must have picked up some more while we were up the top of the bluff."

"That's very interesting, sir. The whole flight has been very interesting, and the view is grand. I'll never forget it, sir," offered Jones.

"I'll never forget that takeoff either," Lieutenant Smith thought to himself as he said jovially, "Let's head back to Bad Tölz and see what's for lunch."

"This is Artillery 1 . . . Send your mission!"

Can You Shoot?

Captain William E. Adams

OR ARE YOU a Lieutenant Lostround? Lieutenant Lostround is an aviator; he loves to fly. However, he leans toward being a throttle jockey more than being an Army Aviator.

Let's put Lieutenant Lostround in a combat situation. He has had the local checkout which covered his flying ability, but did not include his knowledge of possible aviator assignments. Lieutenant Lostround is assigned the mission to fly from point A to point B. On his way, he spots approximately 100 enemy troops massed. To him, it looks like they might impede the progress of the ground gaining units. Realizing he should inform someone of this force, he calls his flight operations center (FOC). They instruct him to maintain surveillance of the target and await further instructions.

Lieutenant Lostround received instructions from the FOC to adjust artillery fire on the target. These instructions include the radio call sign of the artillery unit nearest Lieutenant Lostround's position and its sector of fire. What must he do to get artillery fire on his target?

Do you know?

Lieutenant Lostround realizes he must establish communications and send the target location to the artillery. He transmits, "Artillery 1, this is Cross-Country 5. Over."

Fire direction center replies, "Cross-Country 5, this is Artillery

Capt Adams is with the Special Subjects Division, Dept of Tactics, Fort Rucker, Ala.

1. Over."

"Cross-Country 5, estimating ACP III [air control point] at 45, 100 troops in mass. Over."

FDC transmits, "Cross-Country 5, this is Artillery 1. Contact the FOC with your position reports. Over."

Lieutenant Lostround replies, "Artillery 1, this is Cross-Country 5 with a fire mission. Over."

"Cross-Country 5, this is Artillery 1. Send your mission. Over."

"Cross-Country 5, estimating ACP III at 45, 100 troops in mass. Over."

"This is Artillery 1. Request the location of the 100 troops in mass."

The fire direction center does not know your ACPs. You must use coordinates or a known point to locate your target. If you do not have a means to locate your targets by coordinates, you can request a mark center of sector, then adjust to your target.

Lieutenant Lostround then changes his target location to coordinates, gives the description of the target (i.e., 100 troops in mass). He then tells the FDC the method of control he wishes to employ. In this case, he is not certain of his accuracy in locating the target, thus he uses the control "Will adjust." If his target location were accurate, he could request fire for effect immediately.

The first rounds impact. Lieutenant Lostround observes the strike of the rounds in relation to the target and determines that an adjustment is necessary. He must now use a subsequent fire request. He makes a shift, Right 50, add 400. Lieutenant Lostround is adjusting the rounds from where he is orbiting; however, the fire direction center has no idea of his location.

By omitting any mention of the reference line, the fire direction center will use the gun target reference line and will assume Lieutenant Lostround knows where the guns are located and is adjusting, using the gun target reference line. If he says, Right and add, the fire direction center will issue instructions to the firing battery to shift the gun tubes in right deflection and a greater range setting from the gun tube setting of the preceding round or volley, using a line from the guns to the target as reference.

Lieutenant Lostround does not understand the reference line; he is adjusting the rounds in relation to his position. After he receives the rounds with the right 50, add 400 and they are going farther away from the target, he remembers how he has to use the reference line. He then makes a shift that will bring the rounds back to the target. After realizing his mistake on the reference line, Lieutenant Lostround has jogged his memory and will be able to accomplish his mission.

If Lieutenant Lostround does not know the battery location, he can still adjust these rounds by establishing a convenient reference line.

A convenient reference line is established by the observer transmitting two sets of coordinates to the fire direction center. He labels one set FROM and the other set TO. This will establish a direction. He then places himself at the FROM point looking toward the TO point. The reference line is the first item given in the subsequent fire request.

In Lieutenant Lostround's subsequent fire request, he requested a shift of right 50, add 400. This does not mean his first rounds landed 400 meters short. He is attempting to bracket his target by adding 400 meters and is planning on the next volley of rounds being beyond the target. All he

***Artillery provides** tremendous firepower*

has to do if the rounds do land beyond is continue cutting his bracket in half until he splits a 100 meter range bracket by adding or dropping 50 meters, or until he has rounds landing on the target. Once he has met one of the above conditions, he has met the requirements to end the adjustment phase and to enter fire for effect. What has he accomplished by adjusting? He has determined the exact location of his target so that when the artillery fires for effect, the volume of rounds will have an effect on the target.

The deviation shift Lieutenant Lostround gave of right 50, meant the rounds impacted five-zero meters left of his target. He moved them on line with the target and did not establish a bracket in deviation.

Lieutenant Lostround did not mention the type of ammunition or fuze he wanted to attack the target with. By omitting these items, he told the fire direction center he wanted a high explosive shell with a quick fuze. Had he desired another type fuze or projectile, he would have inserted this request in his initial fire request between the description of the target and the type of control he wished to employ. If he had desired to change either fuze or projectile during the mission, the change (s) would have been inserted between deviation and range in the subsequent fire request.

Should the fire for effect rounds not be centered on the target, Lieutenant Lostround would have to move the fire for effect to the target by requesting a shift such as, Add 50, repeat fire for effect. If the fire for effect did not neutralize sufficiently, then he would request, Repeat range, fire for effect.

The Artillery has a tremendous amount of firepower. However, it does not have sufficient eyes to effectively employ that power throughout an entire battle area. As an Army Aviator, you provide the additional eyes to detect and neutralize targets throughout the battle area. The checklist included will assist you in being the additional eyes to detect and neutralize targets throughout the battle area.

ARTILLERY OBSERVER CHECKLIST

1. Call the Artillery, identify yourself and state FIRE MISSION. (After radio contact is established, continue)
2. Give the target location. (Coordinates)
3. A brief description of the target.
4. Type of projectile you desire. (High explosive assumed)
5. Type of fuze you desire. (Fuze quick assumed)
6. Control. (Will adjust or fire for effect)

SUBSEQUENT FIRE REQUEST

1. Reference line. (If not the gun-target reference line)
2. Deviation. (The amount left or right—minimum, one-zero meters)
3. Type of projectile. (If you desire a change)
4. Type of fuze. (If you desire a change)
5. Range, (Add, Drop or Repeat Range—minimum five-zero meters)

NOTE: Establish a bracket if the first rounds miss your target, add (drop) even multiples of one hundred.

6. Control. (When you have adjusted the rounds to where they are having effect on your target, or you have split a one hundred meter range bracket, fire for effect)

EXAMPLE FIRE REQUEST

Artillery 1 (FDC), this is Cross-Country 5 (FO), Fire Mission, over coordinates 123-456, 40 troops in open. Will adjust, OVER.

EXAMPLE SUBSEQUENT FIRE REQUEST

Cross-Country 5, Reference line, *from* coordinates 145-891 *to* coordinates 148-893. Right 100, add 400, OVER.

***Army Aviation's eyes** help make artillery effective*

What It Feels Like To Eject...

YOU'RE FLYING along in your trusty old OV-1. You are at peace with the world. It's just been announced that you're on the promotion list, you've found that you have the money to buy that new boat, and your girl has said she'll marry you.

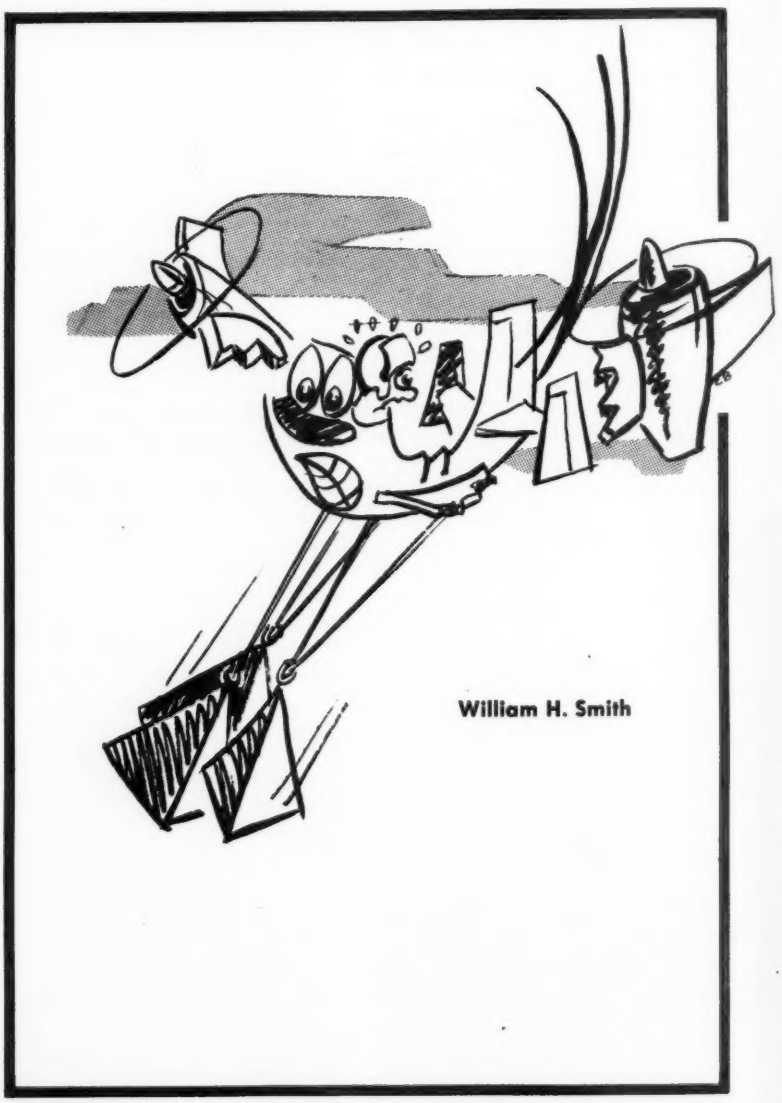
Then it happens. The wings fall off your airplane (don't get excited, as far as we know this has never happened). It's just you, a dead airplane, and the law of gravity.

What happens to your body as you fall toward the ground? What happens when you eject?

Much study has been done on the subject and the Army plans to put its new biomedical-biophysical monitoring system (see U. S. ARMY AVIATION DIGEST, May 1965) to gathering even more information. In the meantime, here is a little of what science already knows.

First, it's not the speed you are traveling that hurts. There is no known limit to the speed you can move in straight and level flight. It's the change of speed and the resistance of your body to that change that causes the trouble. That's why roller coasters are so exciting.

A change of speed is called acceleration and it doesn't make any difference if it's faster or slower. Sometimes slowing down is called deceleration. Accelera-



William H. Smith

tion is measured in gravitational units. These are the familiar "g's."

In general, the higher the g force the greater the effect on the body. However, intensity alone does not tell the whole story. If you undergo 12 g's in a tight turn you could become unconscious if the force lasts for more than 2 seconds. Yet, you receive 12 to 15 g's with no ill effects when jumping from a table 4 feet high. The key is the duration of g force and the rate of onset of g forces. The force from the table lasts only a fraction of a second.

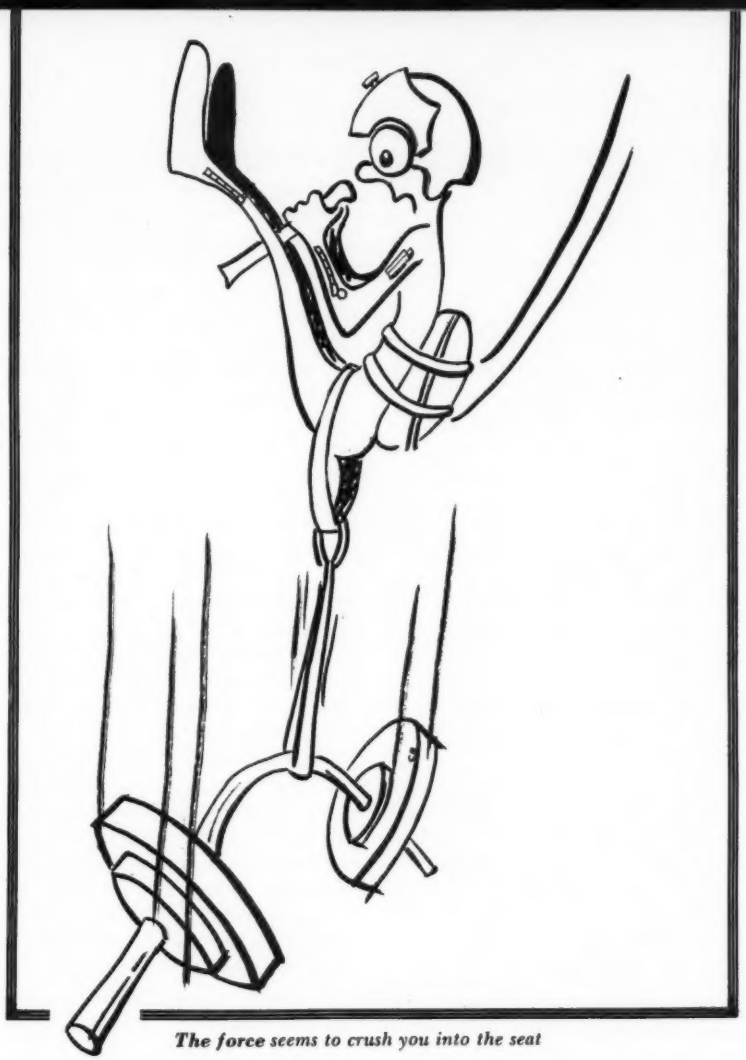
G's may be classified by the direction of forces acting on your body. Each force affects you differently. The acceleration force and the inertial force (equal and opposite to the accelerative force) are considered in this classification.

When the acceleration force is headward and the inertial force is footward, it is commonly called a positive g force. Positive g's are felt most commonly when you are in the upright position during a pullout from a dive. The force seems to crush you into the seat.

In a positive g the heart, lungs, diaphragm, and other organs accelerate at a different rate from the firmer structures. All moveable organs, including the heart, are displaced downward.

The blood in your body tends to pool in dependent parts of your body due to inertia and lack of attachment. The amount of blood in the head and brain is reduced to the point it can affect the body functions.

A 1 g positive force is the normal condition of life. You have grown accustomed to it and don't notice the sensations accompanying it, but let that force be doubled and you immediately feel uncomfortable. Your arms, legs, and head are hard to move. You seem to be very tired and notice that your body weight has increased until it's compressing the seat more. If at this point it becomes necessary to manually bail out of your aircraft, you find it very hard to do.



***The force** seems to crush you into the seat*

Under a 3 g positive force your body is now extremely heavy. One aviator who experienced a 3 g force said he felt as if he weighed 600 pounds. It is already too late to bail out manually—you simply don't have that much strength.

Somewhere between 3 and 4 g's you will notice a dimming of vision, and within 10 seconds after you reach 4 g's blackout occurs. Blackout, however, is not unconsciousness; your mental responses remain good.

Supposedly, you do not lose consciousness until you've reached 4½ g's. Even then it progresses rather slowly. But after 7 g's immediate stunning occurs. Some aviators who have become unconscious under these circumstances say they had dreams and nightmares.

After the acceleration stops it may take from 15 to 60 seconds to recover, and for another 15 to 60 seconds you will be disoriented.

A negative g force occurs when the accelerative force acts on the body in a footward direction and the inertial force is toward the head. Typical examples are during a nose-over or outside loop

when the body is pushed upward into the harness.

When you undergo a 0 to −1 g you get the same sensation as though you were standing on your head. In a −2 g you get a gritty feeling in your eyeballs. You notice a pressure in your head and disagreeable congestion in the soft tissues of the face and neck.

The most pronounced effects seem to occur after a −3 g. Your eyeballs seem to be popping out and your skull seems to be expanding. A severe throbbing headache may persist for hours afterwards. The worst effect, as far as the aviator is concerned, is that he becomes mentally confused and will not be able to operate the controls even if he gets the chance.

You usually can't stand more than −3 g's for more than 3 seconds.

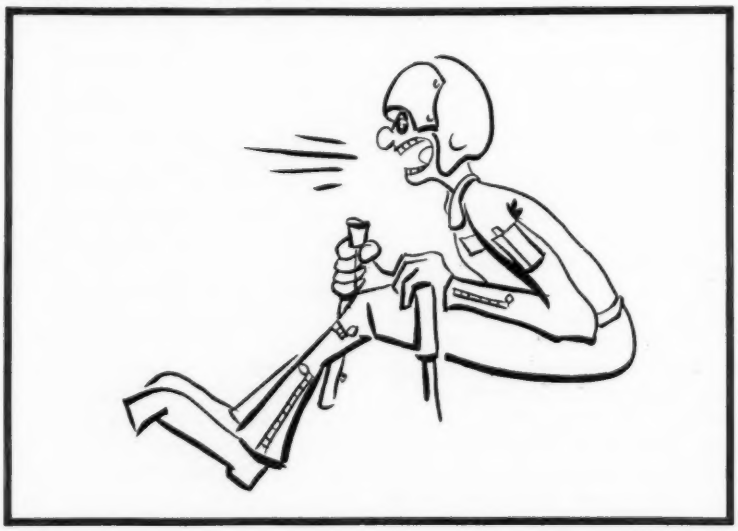
One exception was a pilot who was exposed to 4 or 5 negative g's for 30 seconds and lived through the exposure. He said that in addition to the expanding head, he could not hear, or swallow, and had a choking sensation. He said that he was unable to see, or if he was seeing anything he was so mentally disturbed he could not understand what it was. When the acceleration stopped there were severe pains in his eyes which lasted for hours and he had a headache which lasted for a day.

Duration of exposure is very important in negative g's. The human body can withstand as high as −10 g's provided the exposure is only for a very short period (less than ½ second). In a parachute opening in the head down position, you may receive as high as a −10 g for 0.1 second with no ill effect. A downward ejection produces a negative acceleration of −7 to −8 g, in 0.2 second without affecting the body.

Some aviators have reported a "redout" from negative g's. This is generally thought to be due to vascular congestion in the eye.

Transverse g is the second type of acceleration. It occurs when the accelerative force acts across the body in an anterior posterior direction (i.e., chest to back or back to chest) with the inertial force also across the body but in the opposite direction.

***Some pilots** report that yelling helps*



Unlike negative g's, the body can withstand quite high and prolonged transverse acceleration without undue effects. At up to 7 g's no ill effects are noticed. After 7 transverse g's respiration becomes progressively more difficult. After 12 g's it is very hard to breathe and talk. Men have tolerated 12 transverse g's for 2 to 3 minutes with no other effect except the respiratory one. At 17 g's there is still no blackout, but by this time considerable respiratory discomfort is noticed.

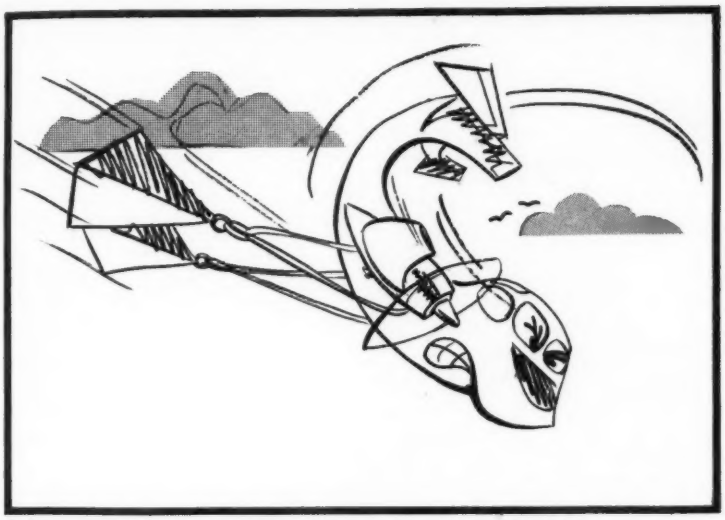
The ability of the human body to withstand a relatively large transverse g is the reason astronauts are positioned to receive transverse g's in rocket takeoffs.

An inherent variability of tolerance is present in each person and even in the same person on different occasions. The physical condition of the subject is important. Varicose veins, umbilical or inguinal hernia, hemorrhoids, eye disorders, prostrating illnesses, hypoglycemia, hypoxia, and chronic low or high blood pressure are factors that decrease tolerance to g forces.

If your health and general physical condition are good you have better stress resistance. Anything that increases your blood pressure helps in the case of a positive g force. The opposite, of course, helps in the case of a negative g stress.

When you are about to undergo a g stress several maneuvers help. Tensing your muscles is one of them. Some pilots report that they have been helped by yelling or grunting during the crucial moment.

Compared to the g forces imposed upon your body in a rocket or high speed aircraft, the forces imposed by ejecting are very tame. When you pull the face blind over your eyes you start four automatic operations. (Sometimes the g force



***G forces** can hopelessly entangle the aircraft in attitudes that make ejecting difficult*

is so great you can't reach the upper handle and must use the lower one instead.) Each has been carefully designed and tested to be in tune with the stresses your body can withstand. The whole operation will take only 4.7 seconds from the time you start until you reach the ground (airspeed of 100 knots at ground level).

By pulling the face handle you fire a primary cartridge in the ejection gun which in turn ignites the two auxiliary cartridges. These furnish the motive power to propel you out of the aircraft. The first cartridge starts the whole procedure and the others act as boosters. In this way, the acceleration is slower, allowing for a lower g force on your body.

It has been found that there is a positive force of about 20 g's on the body at the initial ejection. However, this force lasts for only about 1/5 of a second, well within your tolerance level.

Phase two starts as soon as you are outside the aircraft. Two drogue chutes pop out of the drogue. Their purpose is to stabilize and decelerate you and put your body in the best attitude.

In the third phase you are separated from the seat and the main parachute opens. The g's you feel when the chute opens are no worse than those felt by a parachutist in a normal jump.

The last phase is, of course, the descent to the ground. The 24 foot parachute lowers you at the gentle rate of 23 feet per second.

If you eject at a very high altitude there will be a delay that will occur between phases two and three. This delay lasts until the seat you are in has descended to an altitude of 15,000 to 10,000 feet or until the g force is 3 to 4½. While this delay contributes to your comfort, its main purpose is to prevent damage to your chute and harness assembly.

Sometimes you may "tumble" during the second phase. This is a rapid head over heels rotation of the body. At one time it was thought that tumbling was caused by the windblast. However, it has been found that it is usually caused by a maladjusted ejection seat and the windblast has nothing to do with it.

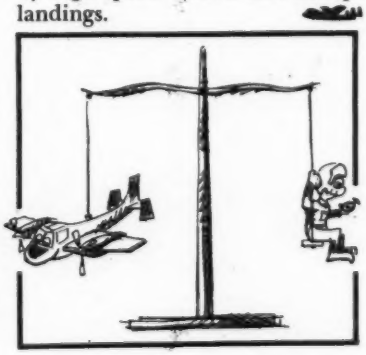
Center of the rotation may be anywhere from the region of your heart to your abdomen. During tumbling acceleration forces drive your blood to the extremities of your body (i.e. headward and footward) at the same time and interferes with the flow of blood through your heart. The excessively high blood pressure in your head and feet may cause hemorrhages in those areas.

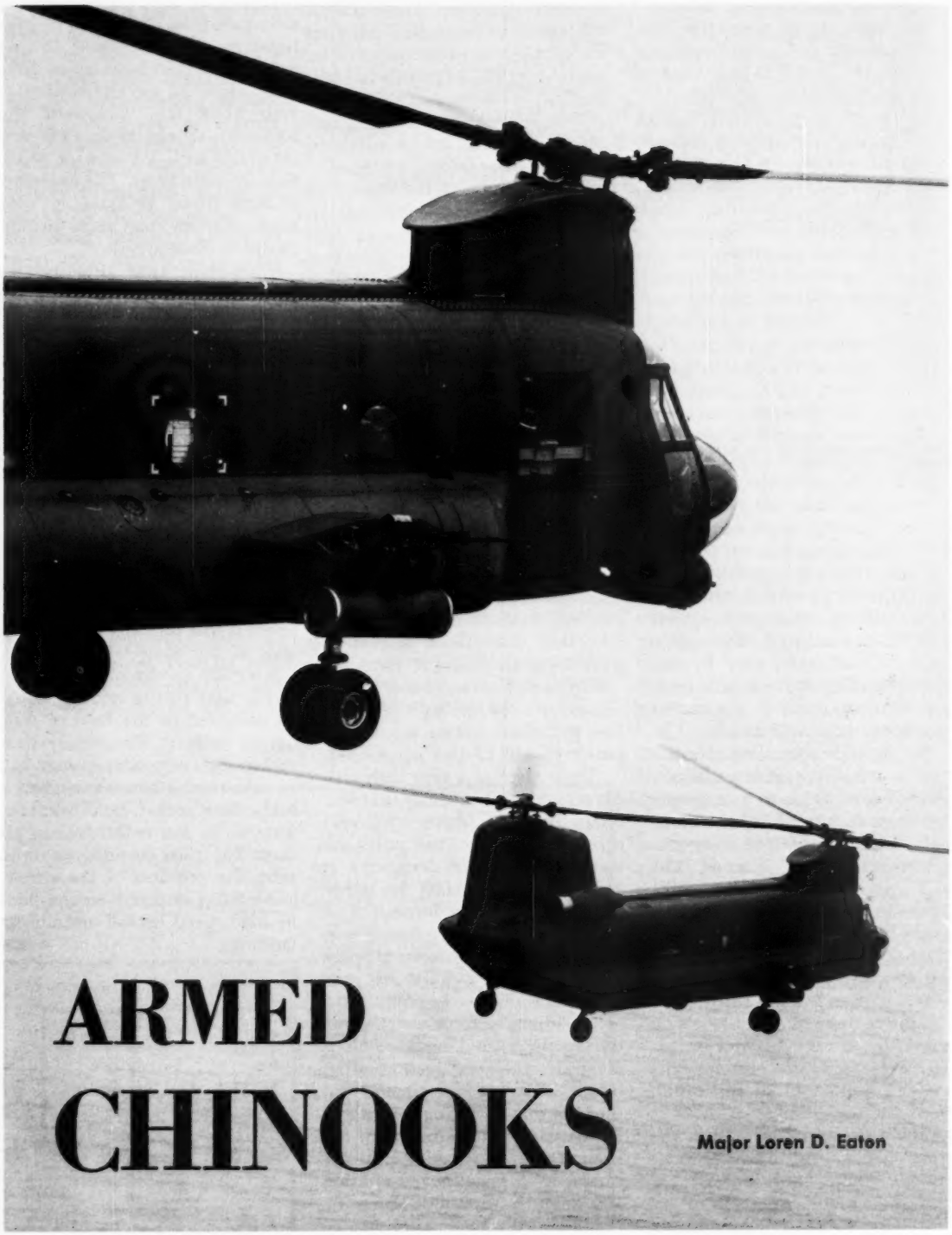
Threshold time for hemorrhages when the center of rotation is your heart is 10 seconds at 100 rpm and 30 seconds at 90 rpm.

Fortunately high speed tumbling does not happen very often and when it does it is quickly checked by the drogue chutes.

There is much we don't know about acceleration. A lot of work has been done on acceleration visual effects, psychology and performance, abrupt and prolonged acceleration, and in other areas. Yet the new field of subgravity and re-entry into earth's atmosphere is still largely untouched in spite of our massive space effort.

Recently it was predicted that in the near future soldiers would be delivered to the field of combat in rockets. We already have rockets that can carry human cargo and we also have the ability to make these rockets land where we want them. But before we can use them for this purpose we must solve the problem of the stresses and strains imposed on the body by high speed takeoff and abrupt landings.





ARMED CHINOOKS

Major Loren D. Eaton

WHILE 11th Air Assault Division tests and combat operations have proved the soundness of the Army's airmobile concepts, they also have revealed weaknesses that must be corrected. One is the immediate need for an aerial weapons platform offering capabilities significantly greater than those of the UH-1B.

As this need became evident, industry responded with several proposals—the armed CH-47A among them. Four of these medium transport helicopters have been retrofitted into armed and armored configurations for Army evaluation.

Development of the CH-47 as an aerial weapons platform is divided into two major areas: armament and armor. Working as a team, the Army and Vertol came up with a wide choice of weapons. These offer a 360° fire capability and about 2,000 pounds of armor plate to protect the CH-47's vital components and its 8-man crew against heavy caliber ground fire.

Armament

The armed Chinook's mission is to escort troop-carrying helicopters, protecting them en route and when they land in assault areas. Weapons to accomplish this were chosen on a basis of fragmentation and round lethality, range, and availability.

To obtain a 360° firing capability (fig. 1), the aircraft is mounted with

- one M-5 automatic 40 mm grenade launcher mounted below the nose section (see DIGEST, May 1965, p. 11),
- one M-24A 20 mm gun and either the XM-18 7.62 mm (Gatling) machinegun or the XM-159 rocket pod (holding 19 2.75″

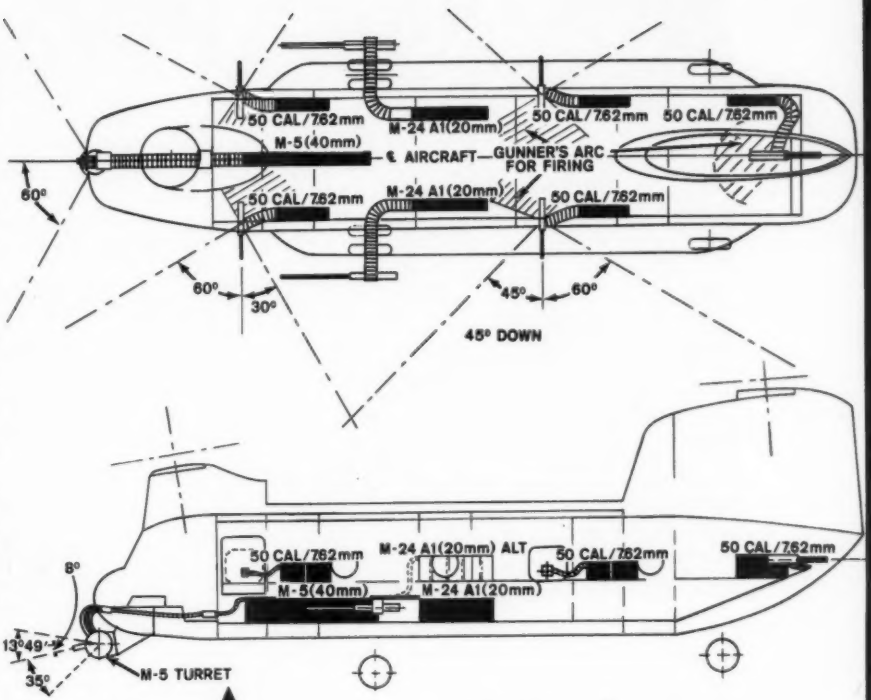
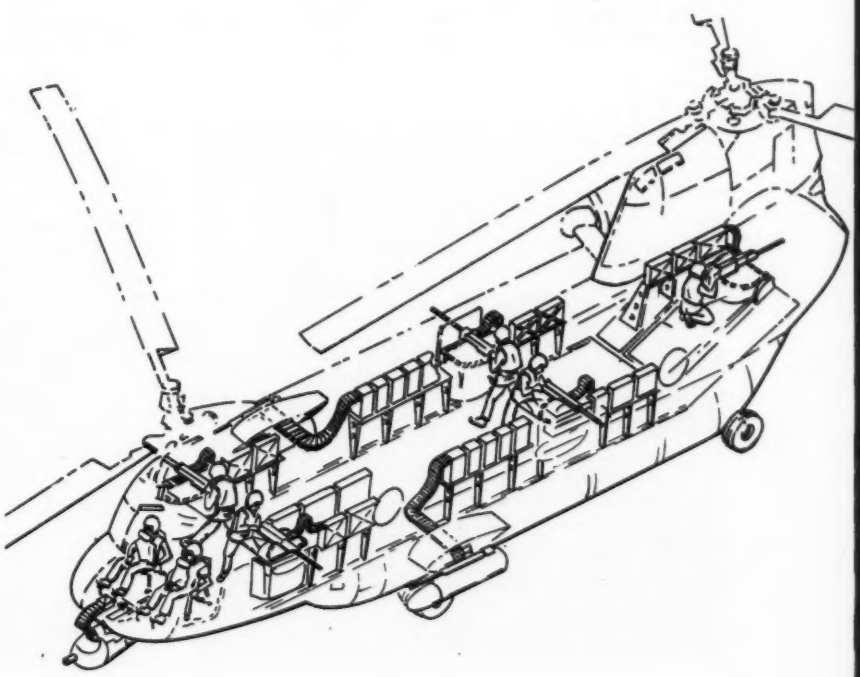


Figure 1

Figure 2



When he wrote this article, Maj Eaton was Chief, Doctrinal Literature Branch, U. S. Army Combat Developments Command Aviation Agency, Fort Rucker, Ala.

Ramp gun—M-2 .50 cal

folding fin aerial rockets) on each side of the aircraft,

• any combination of M-2 .50 cal or M-60D 7.62 mm machine-guns totaling five—two on each side and one on the aft ramp.

Figure 2 shows location of guns and ammo storage containers.

The M-5 is aimed with the M-5 sight and fired by the copilot, who is able to cover an extensive area on either side of the flight path. Ammunition is fed from a container in the forward section of the cabin.

Forward firing is supplemented by the pylon mounted weapons which are located outboard of the forward landing gears. These weapons are fired by the pilot, who maneuvers the aircraft into firing position and uses a fixed sight for aiming. The pilot also can jettison the XM-159 inflight and can use an electric charger to clear jammed rounds from the M-24.

Flank and aft firing is provided by five cabin guns—one mounted at the forward escape hatch, one at the main cabin door, one each on reworked windows in the aft section of the cabin and one on

ARMED CH-47A CHINOOK

Weapons	Total Rds Per Gun	Rate of Fire (SPM)	Muz Vel Ft/Sec	Max Range in Meters
M-5 (40 mm)	500	230	830	1,500 @ 13°
M-2 (.50 cal)	700	700	2,800	6,500 @ 35°
M-60D (7.62 mm)	3,000	600	2,700	3,500 @ 35°
XM-159 (2.75" FFAR)	19	6 pair per sec	2,100	1,500
XM-18 (7.62 mm)	1,500	3,000	2,700	3,500 @ 35°
M-24 (20 mm)	800	800	2,700	5,200 @ 35°

External weapons—M-24A 20 mm gun and 2.75" rocket

Internal weapon—M-2 .50 cal

***The CH-47 can** carry the load. Now the Army wants to see if it can pack the punch*

the aft ramp which is in the closed position with the extension retracted. The .50 caliber M-2 is the main weapon and the M-60D was selected as the alternate because it has a large number of rounds per payload. Either of the guns can be quickly mounted or dismounted at any of the five cabin stations.

Ramp gunners wear a safety restraining harness to allow full mobility while firing. Similar harnesses are provided for the other gunners.

Armor

A new type of steel armor plate is being used in the armed CH-47. The steel undergoes a special heat treatment that results in an extremely high strength to weight ratio. It is mounted in the aircraft in double layers of steel alloy to protect vital areas. Hard outside layers shatter bullets and softer inside layers absorb fragments that may reach it.

Crew seats are unique in that armor is built into them which provides 100 percent torso protection from the front, back, bottom and sides and still permits free movement and unrestricted vision. Seat armor consists of a wrap-around shoulder shield on the outboard side and a forward double door shield hinged at either side of the seat back. Armored seats also consist of quick disconnect features, ventilated cushions and rigid foam chin pads. Provisions are included for adding personnel crotch and head protection.

Extensive dualization of the Chinook's systems combined with armor plate will assure a high degree of survivability.

Performance

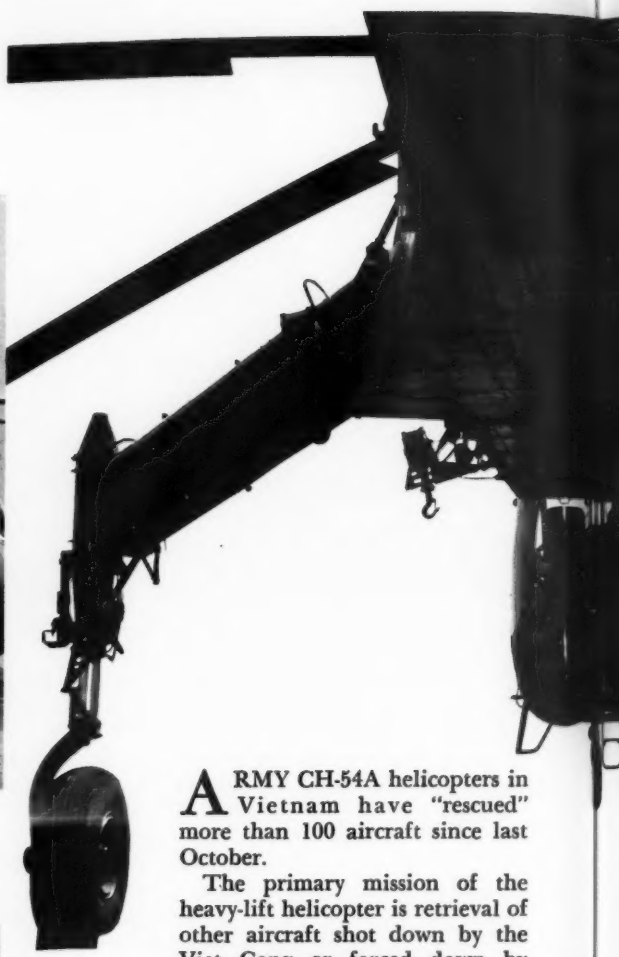
Mission and range are directly related to the armament load. For example, a basic armament package consisting of the M-5 with 500 rounds, two M-24s with 1,600 rounds, two XM-159s, and five .50 cal machineguns weighs about 4,800 pounds and pushes the armored CH-47's gross weight to about 31,000 pounds, depending on ambient conditions. In this configuration the aircraft has a radius of operation of some 100 nautical miles. It carries about 4,000 pounds of fuel, has a mission duration of almost 2 hours, cruises outbound at an average airspeed of about 120 knots and inbound at about 130 knots.

A change in armament load changes mission capability. An alternate armament package drops the M-24s and XM-159s and adds 15,400 rounds of .50 caliber ammunition. This increases gross weight to approximately 33,000 pounds and cuts the radius of operation. It also cuts the outbound average cruise airspeed to nearly 115 knots and mission duration to about 1.80 hours.

Weapons and armor can be easily and quickly removed to convert the CH-47 back into a near standard transport helicopter.

The Chinook has already proved that it can carry the load. Now the Army is interested in seeing if it can pack the punch.

Flying



***CH-54 has** no trouble carrying "people pods" (above) or lifting tanks (below)*

ARMY CH-54A helicopters in Vietnam have "rescued" more than 100 aircraft since last October.

The primary mission of the heavy-lift helicopter is retrieval of other aircraft shot down by the Viet Cong or forced down by mechanical trouble. Rescued aircraft have ranged from the 2,000 pound OH-13 to the CH-47A helicopter weighing nearly 18,000 pounds. Others include the fixed wing A-1E and CV-2, as well as the rotary wing UH-1D and CH-34. Most aircraft recovered in Vietnam have been repaired and returned to flying status.

Other missions flown by CH-54As in Vietnam have included cargo runs: bulldozers, roadgraders, and other engineering equipment airlifted up to 50 miles to build a new airstrip in a forward support area; 155 mm artillery pieces moved, along with men and

Cranes

equipment, from one firing position to another; 500-gallon fuel bags delivered to attacking ground forces; and supplies airlifted from vessels lying offshore directly to distribution centers.

Specially-equipped vans, dubbed people pods, have been carried by CH-54As to forward areas to serve as highly mobile hospitals, command posts, and communications centers.

Estimated total value of aircraft recovered by CH-54As in Vietnam is more than $37 million, about four times the cost of four Flying Cranes.

CH-54As were introduced to the Army in 1964 (see DIGEST, Nov 1964). They received exhaustive tests and evaluation in maneuvers before being assigned to Vietnam. They are powered by twin Pratt & Whitney JFTD-12 turbine engines of 4,050 horsepower each.

***CH-54** recovers downed CV-2 (above) and A-1E (below)*

IT COULDN'T HAPPEN HERE?

Mechanics have been seriously injured through carelessness, a lack of knowledge, and just plain horseplay . . .

Ted Kontos

"SWITCH OFF! SWITCH OFF!" shouted the crewchief as he dived from beneath the wing of a U-8D. His words were lost in the crunching of metal as the gear folded and the airplane settled. Although he lost the race with gravity, he escaped with his life and is now recuperating from leg injuries.

Moments earlier he had been ground checking the assist step. While his assistant in the cockpit operated the fuel boost pump as directed, he actuated the right gear safety switch. The step worked fine, but the gear retracted. This experienced mechanic knew that if the landing gear selector switch should fail and the safety switch was actuated while electrical power was available, the gear would retract. Why, then, weren't jacks or some other type of support placed under the wings?

This recent accident has now joined the bulging files of similar accidents—caused by a moment of thoughtlessness, an it-can't-happen-to-me attitude, a lack of knowledge about the operation of aircraft systems and equipment, or just plain horseplay.

In one instance, painters were to paint a design on the nose section of an airplane. To lay out the pattern, the nose gear had to be in the retracted position and the wheel well doors closed. Because jacks were not readily available, mechanics decided to manually pull the tail down and tie it with ropes. They disconnected the mechanical linkage to the nose gear, positioned the strut in the wheel well, secured it with a rope, and closed the doors. When the job was finished, the mechanics untied the ropes and began to let the tail rise. The tail suddenly shot into the air, carrying aloft one mechanic who stubbornly refused to turn loose, while the nose slammed into the concrete floor. Their expressions radiated a mixture of embarrassment and disbelief as they realized they had forgotten to extend the nose gear.

Two highly experienced mechanics, troubleshooting an R-1340 engine, completed a high voltage ignition harness check, then reconnected the spark plug leads before checking the ignition timing. With the front plug removed from the no. 1 cylinder, one man turned the propeller, while the other held a finger in the cylinder opening to determine the compression stroke.

Mechanics nearby heard a momentary roar and turned in time to see the two bodies being hurled 15-20 feet across the hangar floor. The mechanic who had been rotating the propeller was badly bruised. The second mechanic didn't fare as well. Several months and three operations later, surgeons managed to save his arm which was nearly severed in the accident.

Their oversight? Failure to turn off the magneto switch after completing the ignition harness check.

Standing in front of an aircraft being run up, a veteran mechanic turned his back to the aircraft. His head buried in the cockpit, the operator didn't notice the brakes were creeping. Without wheel chocks in place, the plane inched forward and—

One mechanic worked on the ailerons while another mechanic performed maintenance inside the cockpit. The control wheel got in his way. He turned it aside and—

A seasoned mechanic trying to remove a landing-gear trunnion pin was having trouble loosening the large nut. Instead of going to the tool crib for the proper wrench, he slipped a section of pipe over his wrench for additional leverage. Unfortunately, the wrench slipped off the nut when he gave a hard tug, causing his fist to strike one eye with such force that metal particles on his hand were imbedded in the back side of his eyeball. In a similar accident, a sheet metal worker used an air hose to dust off his cloths after he finished a job and blew metal slivers into his eyes.

Worn threads allowed the chuck of a high pressure hose to come off the strut a mechanic was servicing and strike him in the chest. The force of the blow knocked him out.

Another mechanic, apparently immune to electrical shock, thought it great sport to hold the hot lead of a high voltage ignition tester behind him with one hand and then "innocently" touch someone nearby with the other. He stopped this practice when he was barely missed by a large crescent wrench flung uncontrollably by another mechanic's reaction to the unexpected shock.

One prankster grabbed the legs of a mechanic lying on a creeper, spun him around several times to build up momentum, then released him, aiming the creeper toward a clear area of the hangar. Instead, the creeper scooted under an airplane and slammed into a parked tug.

Sometimes the practical joker can get his "kicks" by simply doing nothing. This was demonstrated in an R-1340 engine buildup shop. Before the engine is hung on the mount, large aluminum washers must be installed on the engine mount bolts. These sandwich the rubber cushions that isolate the engine from the mount. If the engine is mounted first and accessories installed, all must be removed before the washers can be put on. One mechanic forgot to install the washers.

This oversight was noticed by the worker next to him who said nothing—until the job was almost finished. Then, laughing, he jingled the washers.

The sudden realization of what had happened infuriated the first mechanic to a point where he became completely irrational. Grabbing a large ball peen hammer from his toolbox, he ran after the practical joker, swinging wildly with every step and missing only by inches. Fortunately, about halfway across the hangar, he regained his former composure and stopped.

Accidents and near-accidents of this type can be prevented by maintenance officers and supervisors who:

- Provide a continuous on-the-job training program to keep all personnel up-to-date with changes in TMs and maintenance procedures.
- Provide continuous and thorough supervision to ensure that correct and safe maintenance practices are followed.
- Require periodic inspections of tools and servicing equipment to make certain they are fit and safe for use.
- Permit no horseplay around aircraft, shops, or work areas.

. . . one main rotor blade was the first part to hit the ground

Maintenance

UH-1B PILOT: "We took off to the north. I had reached about 20 knots airspeed when there was a loud bang, like something had hit the aircraft. It started to shake and turn to the right. The cyclic control started going all over the cockpit. I cut the throttle, but the helicopter still turned to the right and went into a nose low attitude. I could not keep it level. My main rotor blades struck the ground and we bounced back up, then landed level. When we hit the ground, someone said over the radio: 'Get out, you are on fire!' I asked my copilot if he was O.K. and he said that he was. I got the fire bottle and put out the fire."

Aircraft accident investigation board: "One tail rotor blade and cuff came off and went into the main rotor system, striking one of the main rotor blades with projectile force and shattering a portion of the blade. The reaction of the helicopter with a portion of the main rotor blade broken was severe vibration. The unbalanced condition in the tail rotor fractured the tail rotor gear box mounting bracket. The 90° gear box and remaining portion of the tail rotor assembly fell to the ground 75 meters from the point of takeoff. Because of the extreme nose low attitude as the helicopter settled to the ground, one main rotor blade was the first part to hit the ground. The impact of this blade striking the ground completely destroyed the rotor system, as well as fracturing the main transmission mounts. The transmission broke loose and folded onto the forward cabin. At this time a flash fire in the engine compartment was seen by a witness."

The aircraft was a total loss and the pilot sustained a minor back injury from ground impact.

Discrepancies and conditions: "Tail rotor yoke threads failed from metal fatigue.

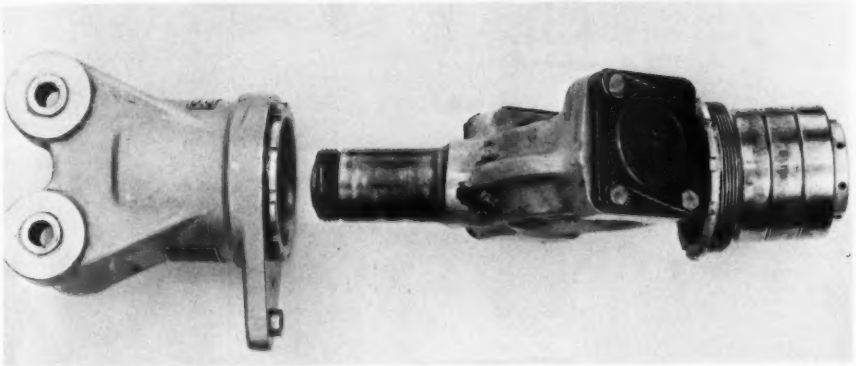
"Blade adapter nut, P/N 204-010-708-3, did not have the required torque. Actual torque, 45 inch lbs; required, 300-400 inch lbs.

"Bearing retaining nut, P/N 204-010-711-1, in blade grip assembly, S/N Q29-704, contained only one cotter key head. Two cotter keys are required, 180° apart.

"Blade bearing set, P/N 204-010-704-1, from blade grip assembly, S/N Q29-704, was incorrectly installed.

crash sense

PREPARED BY THE U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH



***Tail rotor** yoke threads failed from fatigue*

"Blade bearing set, P/N 204-010-704-1, from blade grip assembly, S/N Q29-704, was lubricated with what appeared to be engine oil. The required lubricant for this bearing set is MIL-G-25537 (USAF) AM-1.

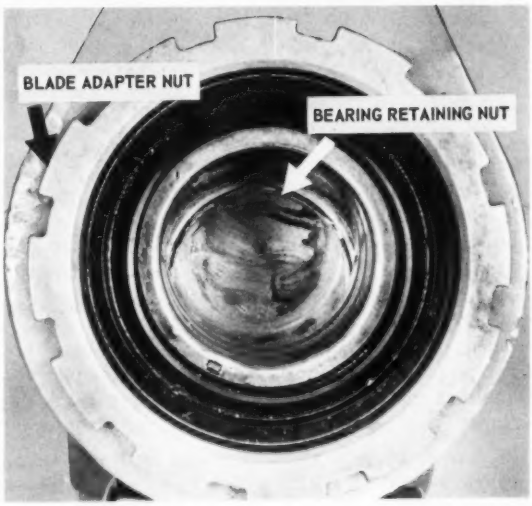
"The blade bearing set on the opposite end of the yoke from blade grip assembly, S/N Q29-704, was rough; disassembly of the bearings revealed badly worn races."

Analysis: "Microscopic examination of the cotter key holes, opposite the one containing the cotter key head, revealed burrs around the periphery of the holes on the inside diameter surface of the nut. If a cotter key had been present in one of the holes, it is doubtful that the burrs would have remained protruding as they were toward the center of the cotter key holes.

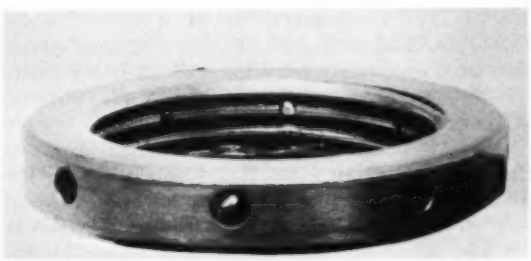
"The bearing retainer nut failed after it had lost torque, sheared the cotter key and rotated to a point where only the two outer threads on the yoke were in contact with the nut. The retainer nut remained in this position until a fatigue crack developed in the second thread root and progressed to a depth of approximately 1/4 inch, and circumferentially from 1 inch, at which time the nut was stripped from the yoke. A portion of two threads in the retainer nut were stripped and a portion of two threads on the yoke were pulled outward under bending forces that were being induced into the blade socket area by pounding of the yoke against the static stop.

"Infrared and microscopic analysis of specimens removed from the bearing retainer nut and yoke threads revealed 'Loctite' had been applied to the thread surfaces. There is no method of determining if the retainer nut was removed after 'Loctite' was applied to the threads and reinstalled without the application of additional 'Loctite.' "

Summary and conclusions: "Investigation and laboratory analysis revealed that the separation of



***Blade adapter** nut was torqued to 45 inch pounds. Required torque is 300-400 inch pounds*



***Bearing retainer** nut. Note burrs around periphery of holes on inside surface.*

***Blade bearing** set from blade grip assembly found incorrectly installed. Note markings*

***Bearing set** correctly installed. Note markings aligned*

the blade grip assembly, S/N Q29-704, from the yoke assembly, P/N 204-010-780-1, resulted after the bearing retaining nut, P/N 204-010-711-1, lost torque, sheared the cotter key, and rotated to a point where only the two outer threads on the yoke were in contact with the nut. The bearing retainer nut remained in this position until a fatigue crack developed in the second thread root and progressed to a depth of approximately 1/4 inch, and circumferentially for 1 inch, at which time the nut was stripped from the yoke."

Recommendation: "That all tail assemblies known to have had maintenance at operational unit level receive a one-time inspection to assure that double safetying of the bearing retaining nut has been accomplished."

DA Form 2028

U-8F IP: "I was giving the pilot his final U-8F checkride. The first part of this ride was under simulated instrument conditions. Another pilot who was to begin U-8F transition training was riding as passenger.

". . . After departing the outer marker, I pulled the left engine for a simulated single engine approach and go-around. The pilot followed the correct procedure for this situation and, at the middle marker, raised the gear handle and started his go-around. The gear indicators showed that both main gear were up, but that the nose gear was still in transit. I gave control of the left engine back to the pilot and told him to hold down the airspeed as I was going to extend the gear. When I put the gear handle down, both main gear extended and locked but the nose gear still showed in transit. I raised the gear handle and got an in transit indication for all three gear. I then placed the gear handle down and told the pilot we would have to extend the gear by emergency means. I pulled the landing gear circuit breaker while he disengaged the clutch and tried to pump the gear down. The gear would not extend. I attempted to get it down but was unable to move the gear extension handle.

"I requested a gear check from the control tower. We made a low pass and were informed that all three gear appeared to be extended approximately

***Partially extended** gear collapsed during landing on foamed runway*

halfway. We climbed to approximately 3,000 feet indicated and I took over the controls, dived the aircraft to about 150 knots indicated, and made an abrupt pullup in an attempt to snap the gear down. I tried this twice with no success. I then asked the tower to contact field maintenance for any additional suggestions. While waiting for a reply, the passenger and I removed the inspection plate covering the landing gear limit switches. We found both free with the sleeve that actuates them positioned approximately halfway between the two.

"The tower notified us that they were in contact with a technical representative who advised us to remove the floor boards in the right front cabin. We removed the right front seat and floor panels and checked the clutch. It was disengaged from the motor gear box and would not re-engage. Using a screwdriver, the passenger was able to engage the clutch and we tried another normal extension without success. We then tried to lower the gear by moving the nose gear chain. Following the technical representative's instructions relayed to us by the tower, we tried these procedures several times, but were not able to get the gear down.

"I requested the control tower to have the runway foamed and told them we would land with the gear in the stuck position. I swapped seats with the pilot, moving him to the right seat, and told the passenger to sit in the left front cabin seat. After making one practice approach, I asked for landing clearance. On the downwind leg, I had the passenger open the cabin door, leaving the chain hooked. I put the props to 2,750 rpm on base leg and put down 40 percent flaps, slowing to 90 knots. I held this speed until over the end of the runway. When we were over the foamed portion of the runway, I told the pilot to feather the propellers and cut the mixture to the engines. He had already switched off the battery and generator switches. The aircraft settled on its belly and I used only enough brakes to keep straight. When the aircraft came to a stop, I told the pilot and passenger to get out. I then turned the fuel and magneto switches off and left the aircraft."

Inspection showed the nose gear actuator clevis rod end had failed at the mounting bolt hole which attaches it to the actuator. A further check showed that the nose gear lock release link assembly (FSN 1560-093-5232, P/N 50-82-0156) had been installed inverted. It had been binding on the spring which is mounted on the clevis rod end shaft, between the clevis rod end and the end of the nose gear actuator shaft.

Assisted by a U-8 technical representative, the investigation board reconstructed the events leading to this accident. Binding of the nose gear lock release link on the spring (P/N 1009-43-YE100P) placed a side load on the clevis rod end, causing it to fail. After the clevis rod end failed, the gear actuator shaft retracted to the full limit of its travel during cycling of the gear. When recycled, the gear actuator shaft extended, binding on the spacer sleeve (FSN 1560-446-1471, P/N 50-410012-59) which connects the left-hand and right-hand fittings

for mounting of the drag brace assembly to the fuselage. This binding of the nose gear actuator shaft against the spacer sleeve completely jammed the entire gear actuating system, preventing normal or emergency extension of the gear.

Inspection of the main gear showed the lock release link on each main gear was also installed inverted. Inspection of another U-8 aircraft revealed a similar condition. The clevis rod end of one gear was badly bent and would have failed eventually had it not been spotted during inspection. These links have also been found improperly installed on U-8 aircraft at other installations.

A check showed that neither TM 1510-201-20, Organizational Maintenance Manual, nor TM 1510-201-34, Field Maintenance Manual, describes the procedure for correctly installing this link. As a result of this accident, and subsequent inspection of other U-8 aircraft, a DA Form 2028 was submitted to include the procedure for the proper installation of these links. In addition, the accident investigation board recommended inspection of these links be incorporated in the daily inspection of U-8 aircraft.

Before this accident, improperly installed nose gear lock release links were discovered on at least two U-8 aircraft, BUT IN NEITHER INSTANCE WAS A DA FORM 2028 SUBMITTED. In the words of the reviewing official ". . . This accident might well have been prevented had the procedures for submitting DA Form 2028 been followed."

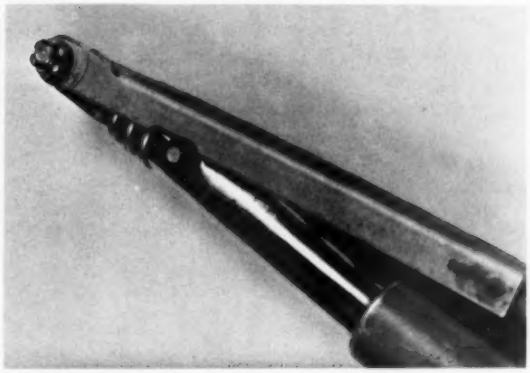
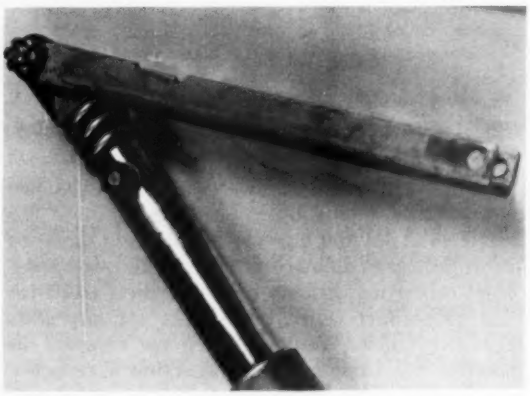
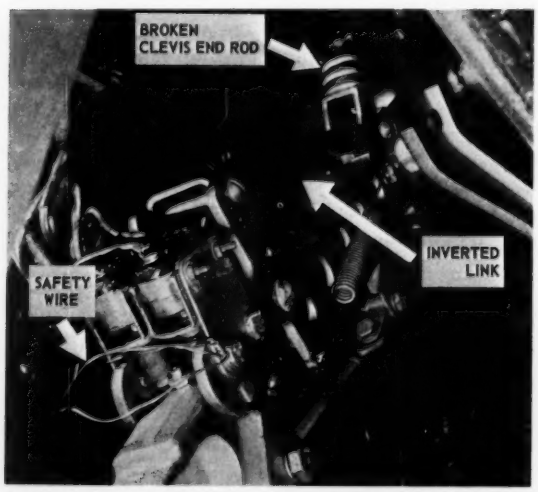


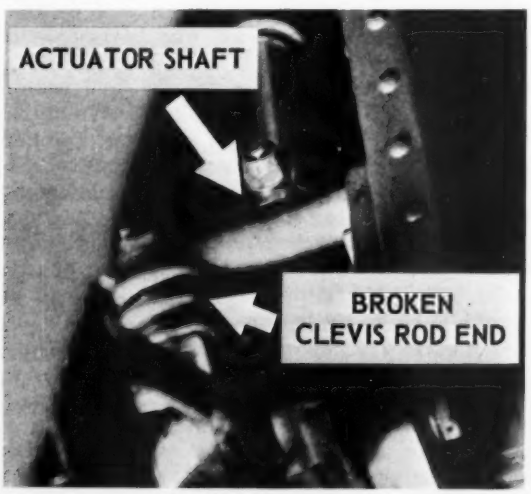
***Photo shows full** travel position of correctly installed gear lock release link*



***Limited travel** of incorrectly installed gear lock release link places bending load on clevis rod end during gear retraction*



***"Murphy" installation** of nose gear lock released link caused failure of clevis rod end*



***Binding of actuator** shaft on spacer sleeve jammed entire gear system after clevis rod end separated*

Again and Again and ??

October 1963— UH-1 major accident happened due to inflight loss of tail rotor control, caused by failure of the tail rotor pitch change link rod end bearing. Failure of the bearing placed a bending load on the link rod, causing it to break.

After the accident, it was found that a washer placed between the pitch change link and pitch horn would prevent bending of the link rod in the event of bearing failure. During November 1963, USAAVCOM sent a safety of flight message to the field (AMCPM-IRFO-11-0228) calling for inspection of all tail rotor pitch change links and the installation of an additional washer below the rod end bearing *before the next flight.*

January 1964— A UH-1B was on a night checkout training flight in cruise flight at 2,000 feet. Suddenly, a loud banging and grinding noise was heard and the helicopter began to fishtail and vibrate severely. It dropped into an extreme nose low attitude and started a turn to the right. The IP took control, found that he had no tail rotor control, and entered autorotation. This stopped the turn and the IP found he could hold a straight ground course with cyclic.

He kept 80 knots airspeed until he was at approximately 100 feet, then started to flare and reduce airspeed. The helicopter touched down with airspeed in a right turn and there was very little impact. The IP had in full right cyclic, but it rolled to the left and the main rotor blades struck the ground. As the blades hit, it returned to an upright position and came to rest. There were no injuries. Damages to the helicopter exceeded $66,000.

This accident was caused by failure of the tail rotor pitch change link due to seizure of the rod bearing. The bearing path of the ball of the rod was found badly corroded. When the bearing seized and the link failed, the tail rotor blade was freed and developed a high propelling force, acting on the splined shift, which drew on the hub retainer nut, followed by the tail rotor hub and blade assembly.

The safety of flight message, sent out 16 months before, had not been complied with for this aircraft.

October 1965— UH-1B passenger: "The weather was clear and the flight was normal up to the point of landing. Just as we were landing, about 10 feet off the ground, I heard a loud noise from the rear of the helicopter. It rocked violently and made a sharp turn to the right. With great difficulty, the pilot kept the helicopter level and we landed rather hard. . . . When we got out, I looked back at the

*"**And the helicopter** landed rather hard"*

crash sense

rear of the aircraft and saw that the entire tail rotor section had been torn away and that the force of the landing had crushed the skids up into the helicopter."

The six occupants of this helicopter escaped injury, but damages totaled more than $57,000.

Among the cause factors listed by the aircraft accident investigation board were:

"Failure of tail rotor pitch change link due to jamming of the rod end which resulted in complete destruction of the antitorque system.

"Failure of organizational maintenance personnel to recognize the extent of wear on the rod end as exceeding allowable limits and requiring replacement of the link or grounding of the aircraft.

"Failure of organizational maintenance supervisors to detect the absence of a jam preventing washer on the pitch change link bolt as required by messages dated 26 November 1963, 3 December 1963, 1 April 1965, and 1 July 1965."

Note: Pages 8-73 and 8-75, TM 55-1520-211-20, dated January 1966, contain displays of the tail rotor pitch change links with washers installed.

Nonconcur

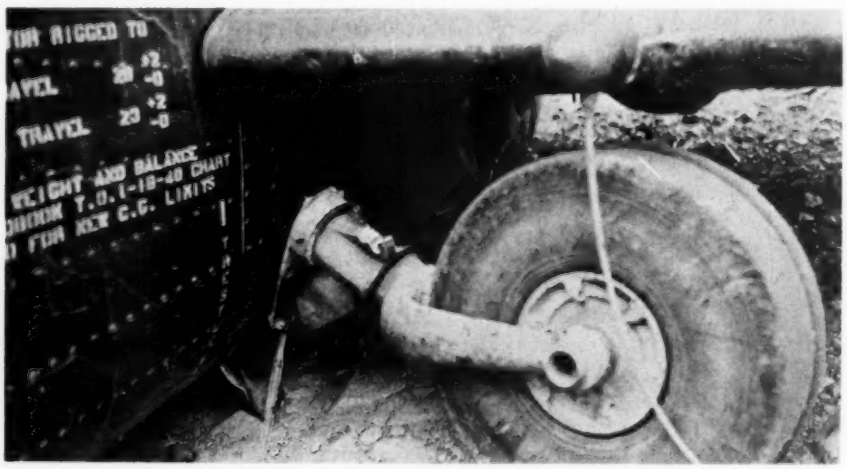
U-6A pilot: ". . . I made a 3-point landing approximately 100 feet past the beginning of the strip, rolled out approximately 1,500 feet, turned around and taxied back to the end of the strip, then turned around again to face into the wind. My tail wheel collapsed. I hit no obstacle while taxiing or turning. . . ."

After investigation, the board listed the primary cause of this accident as "metal fatigue of the shoulder bolt (tail wheel strut assembly) caused by previous undetected crack in bolt at point of breakage." It recommended that shoulder bolts on all U-6A strut assemblies be magnifluxed during periodic inspections.

Aviation safety officer: "Because of the unusual failure of the shoulder bolt an investigation was made by the safety section to pinpoint the reason for failure. . . .

"Examination of the shoulder bolt showed evidence of failure due to shear and bending loads on the threaded portion of the bolt, an area normally subject only to small tension loads. Bending loads are normally absorbed by the shank of the shoulder bolt containing the upward movement of the tail wheel strut assembly.

"Bending of the shoulder bolt near the head indicated that the shoulder bolt was properly positioned in the strut assembly at the time of failure. The strut piston assembly was found to be curved



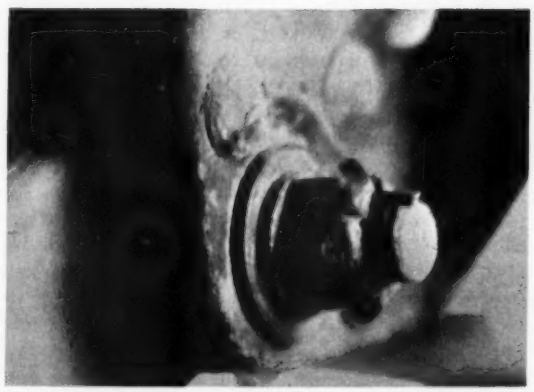
U-6A tail wheel assembly collapsed during taxiing turn

Inspection of 12 other U-6s revealed several incorrect yoke and pivot bolt installations

to the left when reinstalled in its proper position. The rear canted bulkhead had an area of metal torn out from the right shoulder bolt hole to the bulkhead aft limit, indicating a great degree of force pulling the strut assembly and shoulder bolt down and to the left.

"The left side of the rear canted bulkhead showed only a slight outward bend. It was concluded from examining all parts in the vicinity of the tail wheel strut attaching point that failure of the shoulder bolt could occur only after the right side of the rear canted bulkhead had torn out and the strut had moved down and pivoted to the left, bringing the threaded portion of the shoulder bolt into contact with the left side of the rear canted bulkhead. Therefore, the shoulder bolt failure was a result, not the cause of this accident.

***Correct pivot** bolt installation*



***Incorrect installation** of pivot bolt found on another aircraft. Note number of washers used and number of threads showing compared with correct installation*

"Examination of the channel former, which serves as the fuselage attaching point for the tail wheel yoke assembly and pivot bolt, showed the area around the left pivot bolt hole had torn out, while the right side was intact but elongated. Normally, the pivot bolt passes through the left tail wheel pickup bracket, the left side of the channel former, then passes through the yoke assembly, with a sleeved bearing on each side to reduce yoke side play. The bolt then passes through the right side of the channel former and the right tail wheel pickup bracket where it is secured with a flat washer, castellated nut, and cotter key.

"The right tail wheel pickup bracket showed no sign of a washer having been installed. The yoke assembly pivoted 90° to the left as the accident occurred. The right side of the channel former should have shown damage from the pivoting yoke *if* the pivot bolt was in position and properly secured.

"It is probable that with no washer installed, the castellated nut, over a period of time, bore tension loads beyond tolerance and either sheared threads or backed out, shearing the cotter key. Once the castellated nut came off, the pivot bolt could either back out, or the threaded portion could become subject to bending loads it was not designed to withstand as a side load was applied to the tail wheel assembly.

"Inspection of 12 other U-6s revealed several incorrect yoke and pivot bolt installations. One incorrect installation, with the wrong size washer and sleeve bearing installed backwards, was found. . . ."

Reviewing official: "Nonconcur with the cause and recommendation of the board. The most probable cause of this accident is maintenance error in that the yoke pivot bolt was incorrectly installed without a flat washer (FSN 5310-475-0203), and the sleeved bearing (FSN 1560-662-5463) was probably installed backwards, allowing the pivot bolt to fail or back out a sufficient distance to cause the tail wheel assembly to fail when subjected to a side load.

"Recommend a one time inspection of all U-6A tail wheel assemblies . . . for proper installation of the pivot bolt, sleeved bearing, flat washer, castellated nut, and cotter key."

crash sense

Lubrication

UH-1D pilot: ". . . I called the tower and told my position and requested landing instructions. My approximate position was 2 miles from the runway, 500 feet above the water, and approximately 1/4 mile from the closest land.

"The first indication of any trouble was a loud bang from the rear of the aircraft. Then my rpm dropped. I lowered the collective, entered autorotation, and turned left to the only suitable landing area.

"I wasn't able to reach my intended landing area and had to attempt a landing on a group of rocks. I pulled all available collective prior to touchdown.

"After landing, the engine was still running and all attempts to shut down failed. I departed the aircraft and was evacuated to the hospital."

The pilot and copilot sustained fractured vertebrae from impact forces and damages to the aircraft exceeded $127,000.

Cause: The engine to transmission drive shaft was improperly lubricated, causing it to lose its flex action. This placed an unusual load on the curvic coupling adapter which ultimately caused it to fail.

Unit commander: "Due to the critical nature of the internal lubrication of the drive shaft, this item should be inspected by a qualified technical inspector and appropriately recorded. This organization now requires a maintenance supervisor or technical inspector to visually inspect each end of the drive shaft to ensure that it is properly lubricated prior to reinstallation."

Overtorque

One of a flight of three, a UH-1B was orbiting at 4,000 feet when it was seen to make several oscillations. The main rotor system separated from the helicopter and floated to the ground. The remainder of the helicopter crashed at a 45° angle with an estimated speed of 95 knots, exploded, and burned. The four occupants were killed and the aircraft was destroyed.

Accident report analysis: "Based on the facts obtained during the investigation, the board is of the opinion that the support attaching the left lateral rod end trunnion to the stationary ring failed, allowing one rotor blade to move into full high pitch and resulting in uneven loading of the rotor system. This resulted in severe mast bumping, crushing the mast on both sides, causing it to fail, and allowing the upper rotor system to tear free from the aircraft.

"This failure was probably due to overtorquing of the attaching bolts securing the trunnion to the stationary ring, and possible misinterpretation of TM 55-1520-211-35 by maintenance personnel on procedures for the installation of the rod end trunnion to the stationary ring.

"The board was unable to determine the exact torque applied to bolts securing the trunnion to the stationary ring. These bolts had been retorqued approximately 15 hours earlier. However, several other stationary rings which were removed from aircraft at the same location were inspected and similar breaks were found, leading to the conclusion that improper torque was applied to the bolts."

***UH-19D made** hard autorotative night landing when clutch failed due to improper maintenance*

Undertorque

. . . the cause of this accident was found to be failure of the hydromechanical clutch

UH-19D IP: "I gave a forced landing to the student on the downwind leg of the night traffic pattern. His reaction to the forced landing was excellent. He called the tower to advise that a simulated forced landing was in progress, lowered pitch, put on the landing light, established his attitude, and made a 180° left turn toward an open field. . . .

"At approximately 200 feet, I ordered him to recover. I was not on the controls, but close to them, and monitoring his recovery. The initial recovery seemed normal. Then I noticed the needles were not joined and the engine tachometer went beyond the rotor tachometer, and the rotor tachometer began to fall off.

"I took control and noticed a continued increase of engine rpm and a slow decay of rotor rpm. I then tried reducing throttle, but it appeared to have no effect. . . .

"I lowered pitch to get rotor rpm and suddenly we were near the ground. We made a near vertical descent and the aircraft felt sloppy. I think I pulled pitch near the ground. Ground impact was hard. . . ."

The cause of this accident was found to be failure of the hydromechanical clutch. Here is what a teardown inspection of the clutch revealed:

"No safety on nut at top of unit.

"Nut FSN 5310-208-8903 was not finger tight. Washer under nut could be turned with fingers.

"Nut FSN 5310-637-0757 had a breakaway torque of 35 foot-pounds. Torque should have been approximately 600 foot-pounds. Nut FSN 1560-397-1604 was the same.

"Fore and aft fluid couplings contacted each other.

"Flyweights and area were void of oil and had been operated dry.

"Plate of clutch was galled and showed signs of burning.

"Rollers showed evidence of freezing and not rotating. The rollers had been so hot that the temper was gone.

"The splines were worn in the cam and the fluid coupling was loose due to insufficient torque.

"The free wheel unit was dry and inoperative."

crash sense

Double Trouble

***Engine failed** at 500 feet. Box end wrench found in equalizer tube. Carburetor acceleration pump plunger worn out*

OH-23C pilot: "My engine failed at 500 feet. I immediately bottomed collective and went into autorotation straight ahead. I glanced at the tachometer and saw that both needles were at zero rpm. I moved the cyclic and the aircraft responded well, so I knew I had rotor rpm.

"I made a gradual turn of approximately 90° to the east to avoid and land parallel to some high line wires which were directly in my flight path. After the turn, I began to slow from approximately 60 knots to about 25 knots. The ground was sloping away from me. I pulled pitch at 6-8 feet. The pogo stick touched first and then the skids. The helicopter bounced twice, the right skid toe dug in, and it rolled on its right side.

"I received a sharp blow on the head at the time the helicopter went on its side, but was not knocked unconscious. I released my safety belt and shoulder harness, then took off my helmet. The helmet was broken in front and the visor was also broken. I saw that I was bleeding from facial cuts and got out."

Thanks to his helmet, this aviator escaped with minor head injuries. Damages to the aircraft amounted to $13,830.

A teardown analysis was made of the engine. This analysis exposed two dangerous conditions:

- A 7/16" X 3/8" box end wrench was found in the intake equalizer tube.
- The carburetor acceleration pump plunger was worn out and the unit was filled with rust and corrosion.

"I Left It Hanging From the Tail Boom"

OH-13H crewchief: "I went up on a test flight to check for a lateral vibration which the pilot and I thought was in the sprag mounts. We landed in the hovering area a couple of times and I made some adjustments on the sprag mount bolts. Later, we decided to return to the hangar and check the alignment of the mast.

"We came back and parked on the ramp across from the hangar. The pilot said he would like to get this work done within a half hour if possible, so another crewchief and I started to work on it.

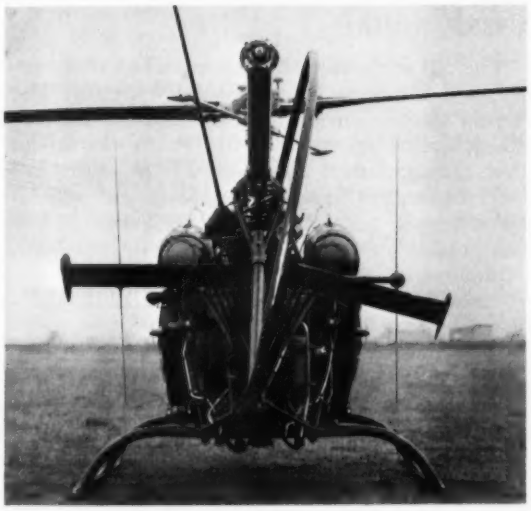
"I had to put the main rotor tiedown on because there was another OH-13 beside us turning up. We aligned the mast longitudinally, then had to turn the main rotor blades to align the mast laterally, so I removed the tiedown from the blade. I got under the aircraft and adjusted the lateral sprag mounts. Shortly after this, the pilot returned and sent the other crewchief for some tools for possible later adjustments.

"We got into the aircraft and the pilot started it up. The other crewchief returned with the tools and we took off. After a few minutes of flight we found that we still had our vibration, so we landed in the hovering area and I got under the aircraft and adjusted the sprag mounts again.

"We took off again and experienced extreme vibrations. I turned around and saw over the top of the engine that our tail rotor was coming apart. The pilot landed and we got out and started looking over the aircraft. We saw the tiedown strap hanging on the tail boom and realized what had happened."

Question: "What did you do with the blade tiedown block after you took it off?"

Answer: "I left the mooring block hanging from the tail boom after the other helicopter left the area, then I crawled under the helicopter to check the sprag mounts. The pilot came out and we got into the helicopter and started the test flight again. I guess I completely forgot about the mooring block."



***Forgotten tiedown** block wiped out tail rotor*

"Tightened Lubricated, and Replaced Spacer"

***$5,000 damages** from defective tail wheel which had been written up four times, but not repaired*

TO-1D pilot: "During the preflight, I looked at the directional lock on the tail wheel and found it to be worn to the extent that the wheel would not lock in steering position. I brought this to the crewchief's attention and he said it had been flown in that condition . . .

". . . Approach and roundout were all normal and there was no indication of trouble at any time. The aircraft settled in a 3-point attitude and the landing was smooth. The tail wheel reacted as if it was turned 90° to the path of landing. I corrected with full right rudder and brake, adding power to compensate for the crosswind. At one point the aircraft seemed airborne. As we settled back to the ground, the right gear was washed out. . . ."

Investigation board analysis: "A detailed review of maintenance records covering the previous seven months revealed an extensive history of deferred and questionable maintenance. The tail wheel assembly had been written up on four separate occasions, with no evidence of any thorough inspection or repair action, other than 'tightening, lubricating, and replacing of spacer.'

crash sense

"The tail wheel assembly was removed, disassembled, and inspected by a technical inspector. The internal mechanism was not defective, but the self-locking nut of the eye-bolt tail wheel tiedown was loose, causing lateral movement of the entire tail wheel assembly. Considerable chafing and wear at this attaching point indicated the looseness had been present for an extensive period of time."

Question to crewchief: "What is your job?"

Answer: "Crewchief for three TO-1D aircraft."

Question: "What is your experience on this type aircraft?"

Answer: "None."

Question: "Do you complete the daily inspections?"

Answer: "Yes. It takes about 30 minutes."

Question: "Did you inspect the tail wheel on this aircraft?"

Answer: "Yes, it was O.K."

Question: "Did you ever work on the tail wheel?"

Answer: "No, I haven't had any experience with it."

Incidents, Forced Landings, Precautionary Landings

UH-1B right transmission cowling came off, causing incident damage to main rotor blade, left and right transmission cowling, and left engine cowling. Cowling was not properly secured.

OH-13H engine failed at hover and aircraft was autorotated. Mechanic's rag was picked up by rotorwash and thrown into no. 1 hanger bearing, wrapping around short shaft. While revolving around short shaft, rag broke cotter key holding retaining pin to fuel shutoff valve. Valve closed and engine failed due to fuel starvation.

O-1A engine ran rough, then failed on final approach. Caused by excessively rich mixture due to maladjusted carburetor.

U-6A chip detector warning light came on intermittently. Caused by wire to chip detector chafing on engine cowl.

U-8D no. 1 propeller went to full low pitch and would not feather. Nut holding governor push-pull tube to governor control arm backed off, allowing governor to go into full low pitch. Cotter pin to secure nut had not been installed.

U-8D right main landing gear would not indicate green on test flight. Emergency procedures were followed. Caused by improperly adjusted microswitch.

OH-13H engine suddenly lost power in cruise flight. Aircraft was autorotated. Caused by improper installation of rocker arm assemblies which resulted in failure of exhaust valve. Valve was ingested into cylinder and no. 6 piston disintegrated.

U-8F right main gear indicator showed unsafe. Caused by dirty microswitches.

CV-2B aileron control became sluggish after takeoff. Left wing had recently been replaced by field maintenance. Suspect turnbuckle on left outboard aileron cable had not been safetied.

UH-1B shuddered violently and started right turn during hover to parking area. Aircraft was autorotated. Caused by failure of retaining nut for tail rotor tube assembly, probably due to overtorque.

UH-1B had high frequency vibration at 150 feet after takeoff. Tail rotor failed and aircraft was autorotated. Cotter key and nut were missing from pitch change shaft in 90° gear box.

OH-23G right lower door hinge pin dropped out during maintenance test. Door folded up at center hinge line, striking and breaking several large pieces from upper cabin inclosure. Caused by improper installation of hinge pin.

OV-1A top ring cowl on no. 1 engine came off and hit center vertical stabilizer, causing incident damage to stabilizer. Suspect cowl was improperly secured.

CH-47A left aft pylon work platform came open. Suspect platform was improperly latched.

CV-2B had excessive amount of oil on no. 2 engine cowling and wing. Engine was shut down and propeller feathered. Oil leak caused by crimped rocker box cover gasket, no. 12 cylinder. Rocker box cover was warped.

UH-1A transmission oil pressure fluctuated. Caused by loose nut on tube assembly.

UH-1B lost transmission oil. Caused by hole chafed in tubing line that runs between transmission oil filter and oil cooler.

CH-47A had high frequency vibration. Caused by improperly lubricated no. 1 drive shaft bearing.

U-6A engine backfired and cylinder head temperature rose to 350°. Engine backfired each time power was reduced. Caused by excessively lean mixture.

OH-23D engine failed and aircraft was autorotated to small clearing, with incident damage to main rotor blades. Cam shaft attaching bolts worked loose, releasing lock plate. Suspect bolts were improperly torqued.

UH-1D whipped sharply 90° to right as it entered translational lift during takeoff. Pilot reduced power, streamlined aircraft, slowed turn, and completed successful forced landing from approximately 25 feet. Suspect tail rotor pitch change rod bearing was improperly installed. Suspect nut holding retainer plate and bearings in end of pitch change rod was torqued after cotter key was installed.

UH-1D transmission oil pressure warning light came on and oil pressure dropped to 10 psi. Caused by failure of transmission oil line due to chafing against transmission housing.

UH-1B engine oil reservoir exploded during ferry flight. Oil vent line had been capped off by mistake.

UH-1D engine failed at 4,000 feet. Aircraft was autorotated. Caused by unsecured main fuel quick disconnect.

OH-23D throttle froze in cruise flight. Student pilot turned off mags and autorotated. Throttle boot found lodged in throttle cable.

U-1A pilot heard loud pop climbing through 5,000 feet during test flight and engine ran very rough. Power was reduced and aircraft landed. Rear spark plug from no. 3 cylinder missing. Suspect improper installation of plug during PE.

UH-1D engine failed. Rag found lodged in engine intake. Intake screen had been removed by mechanic for cleaning immediately prior to failure.

U-6A engine failed. Left magneto found 70° out of time. Spark plugs had cracks in porcelain.

O-1A pilot smelled strong odor of fuel and noted fuel running into his right boot. Caused by leak in inlet fuel line fitting to hand primer at firewall connection. Fitting worked loose.

OH-13S pilot noted high cylinder head temperature. Caused by refueling reciprocating engine aircraft with JP-4 fuel.

OH-23F generator warning light came on and went off during landing. Pilot inspected aircraft, found nothing wrong, and took off again. Generator warning light came on again and pilot saw oil pressure decrease. Condenser, mounted on generator, shorted across main oil line, causing break in oil line. Clamp slipped and allowed condenser to rotate downward against oil line.

U-8F left main gear gave unsafe indication. Caused by excessively tight installation of landing gear clevis bolts which prevented activation of microswitch.

CV-2B flight engineer saw oil covering cowl when he checked main gear down during approach. Aircraft was landed and engine shut down. High pressure oil tube which passes between no. 6 and no. 7 cylinders was chafed through by deicing fluid tube. Failure occurred halfway between no. 7 cylinder and aft end of oil tube and allowed 9 gallons of oil to escape in about 5 minutes. Oil and deicing fluid tubes were apparently installed in contact. Normal distance between tubes at failure point is 2 inches.

CH-34C stick trim came on and burning smell was noted in cabin at 1,500 feet on GCA final. Smoke appeared from behind instrument panel and generator warning light came on. Battery switch was turned off and helicopter landed. Caused by frayed wire which resulted in voltage regulator failure.

UH-1D pilot saw oil pressure decrease and oil pressure warning light came on during test flight. Caused by disconnected oil line. Line was disconnected during inspection.

U-8F no. 2 engine caught fire during runup before maintenance test flight. Engine accessories, electrical wiring, oil hoses, and firewall damaged. Tool marks were found on leaking O ring of fuel strainer and fuel pressure check was not made after fuel screen inspection during periodic maintenance.

U-8F was being run up after MWO compliance when black smoke and flames were seen coming from no. 1 engine. In addition to engine damage, fire damaged the left wing flap and cabin door hand line. Cause of fire was a loose connection between the fuel tubing assembly and the heater solenoid inlet fitting. Tubing was removed during MWO compliance, but this was not entered in the aircraft workbook and the loose fitting was missed during four separate inspections.

U-8F was being run up after PE when mechanic saw smoke and flames coming from cowling of no. 1 engine. Fire caused $1,200 damage to engine. A connection on the pressurized side of the primer solenoid was found loose enough to turn with finger pressure.

Hundreds of common drugs are available without prescriptions—and too often we use them not realizing some could be killers if improperly used. This article describes just such a drug, but does not identify it until the conclusion. See if you can determine its name without looking ahead.

Triple Threat Drug

AN AVIATOR IS engaged in a hazardous occupation—one that can be dangerous not only to himself but also to others. For this reason he must be very careful about the kind and amount of drugs and medications he uses. He must consider the effects drugs might have upon his health and his ability to perform his duties.

Generally, Army Aviators do a very good job of controlling their use of drugs. Strong drugs are just not used, and when an aviator feels the need of milder medications he can be depended upon to consult a flight surgeon.

One drug is so common that most aviators don't recognize it for what it is. Unfortunately it is very hard to control, as it is sold without a prescription in many sections of the United States. In some states it can be bought in the supermarkets along with eggs, sugar, and flour.

When taken orally, it's absorbed completely and rapidly and is distributed by the blood to different organs of the body where it oxidizes at about ½ to 1 ounce per hour.

It is a fat solvent and a disinfectant and has a tendency to contract body tissue and blood vessels, reducing the flow of blood. It also affects the heat regulating center in such a way that the user feels warm even though he may be losing heat quite rapidly and his internal temperature is falling. Perspiration may even occur, which, of course, causes a further loss of heat.

It acts as a depressant on the nervous system but produces euphoria, a temporary feeling of exhilaration, by suppressing the higher controls, such as self-criticism. It affects muscular skill, sensory acuity, memory, and other measurable psychological functions.

Prolonged use of the drug makes the addict more susceptible to general diseases and reduces his ability to withstand surgical operations. It can be the direct cause of such diseases as chronic gastritis, cirrhosis of the liver, multiple or peripheral neuritis and mania.

If taken in one form, the constant use of this drug will cause the addict to become overly thin. It seems to affect the gastrointestinal tract in such a way that little or no nourishment is absorbed. In another form, it acts in the opposite way and the regular user becomes fat.

Probably the worst effect on the human body is that it leads to addiction, and once the habit is established it is very hard to throw off.

The number of aviators who use this drug has never been determined, but it has been found that 2½ percent of the steadily employed persons in the United States are addicts. It is safe to assume that this percentage will hold true for aviators as well. The FAA has found that aircraft fatality rates are five to six times greater in those cases where the aviator was a known user.

FAA officials studying the problem admit they are faced with a formidable task. They can take punitive action against users of the drug under part 43.45 of the Civil Air Regulations. This regulation places the onus on the pilot. It stipulates that a person shall not pilot an aircraft nor serve as a member of the crew while under the influence.

This drug is one of man's oldest enemies and has been causing trouble since ancient times. In case you haven't guessed it by now—it's *alcohol.*

If you are a user, remember, you have a better chance of survival in the flight game if you reduce or eliminate your intake. Don't be misled, its use requires as much discretion as any common drug.

Major Frederick L. Clapp – $250

Lt Col Milton P. Cherne – $150

Lt Col John G. Cleveland – $100

Annual Writing Awards

A New Kind of War	**Maj Frederick L. Clapp**	**Jul 65**
Doubleheader Airmobile Operations	**WO Bruce P. Mauldin**	**Aug 65**
Instant Soldiers	**Lt Col Milton P. Cherne**	**Sep 65**
Professionalism	**Lt Col John G. Cleveland**	**Oct 65**
Army's New Sidearm	**Capt Robert L. Webster, Jr.**	**Nov 65**
Flight Fashions	**Lt Col George W. Aldridge**	**Dec 65**
Skyraider Support	**Capt David H. Price**	**Jan 66**
More New Kind of War	**Maj Frederick L. Clapp**	**Feb 66**
No Runs, No Hits, No Errors	**Lt Col Patrick N. Delavan**	**Mar 66**
Stay Alive With Your .45	**CWO Ernie L. Greening**	**Apr 66**
On a Long Wide Base For 09	**Capt Joe J. Matthews**	**May 66**
Would You Believe Four Fingers	**Capt Donald J. Mascia**	**Jun 66**

Top Awards Upped to $250, $150, $100

$25 Monthly Prize

LIKE TO EARN a little extra money? Then write an article for the DIGEST!

Beginning with this issue, the sixth annual writing contest gets underway with new monthly cash awards and increased annual awards. Cash awards for the top three articles have been doubled, and for the first time each monthly winner will receive a $25 cash prize in addition to an engraved bronze plaque. The best article of the year will receive $250; second prize will be $150; and the third place winner will receive $100. (Due to an unexpected increase in available funds the top three 1965-1966 award winners received the new amounts.)

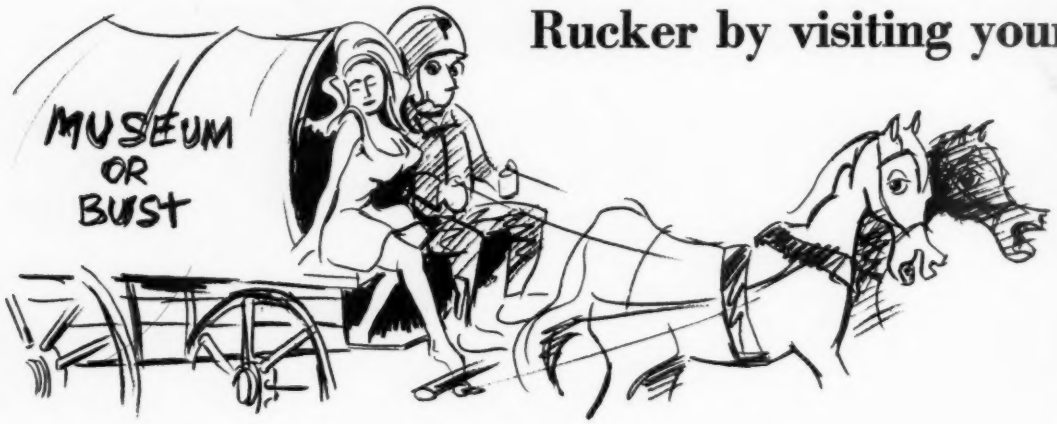
If you have not submitted an article to the DIGEST, now is your chance to win a substantial cash award for your efforts. To be eligible for the contest, an article must be an original manuscript on some aspect of the magazine's mission (see inside front cover). It must not have been previously released to the public. Articles which have already been submitted but not yet published are automatically eligible for the new contest.

By all means send any appropriate pictures, diagrams, charts or other illustrative material with your manuscript. If these are unavailable, the editor would like to receive any ideas you might have for illustrations. Such material will not influence judging of your article for the contest.

Articles chosen for publication will be typed in the author's original form and submitted unedited and without bylines to contest judges. These general criteria will be used in selecting winning articles: accuracy, completeness, originality, readability, reader appeal, soundness, substance, and overall merit.

Manuscripts or queries concerning articles should be mailed to: Editor-in-Chief, U. S. ARMY AVIATION DIGEST, Fort Rucker, Ala., 36360.

Army Aviation has a proud heritage. "See" it on your next trip to Fort Rucker by visiting your



Army Aviation Museum

THE U. S. Army Aviation Museum at Fort Rucker, Ala., soon will be expanding into a larger building and come under the direction of a full-time civilian curator.

Plans call for the museum to begin relocating by fall into the 14,600 square foot shop-type building near the link training building on main post. When a curator is hired, displays will be organized to tell the story of Army Aviation. The theme of the museum will be "Army Aviation in support of the ground operation." Studies are being made to determine how best to organize displays to reflect significant roles of people, hardware, installations, units and organizations, along with such nontangibles as training procedures and tactics.

The museum was organized in 1955 and grew slowly. In 1963 it was recognized as an official Department of the Army museum. It is now in possession of much valuable material, such as the Army's first L-19 (0-1); the first L-20 (U-6) engine; the XH-40 (test model of the Huey); Bill Brake's original log kept while setting the medical evacuation record in the Korean War; what is believed to be the first TOE chart of the Aviation School at Fort Rucker; maps used by Army Aviators participating in the Normandy invasion; and many other items.

Currently the museum is anxious to receive material, either as a gift or a loan, ranging from maps, pictures, and through aircraft from Vietnam, Europe, CONUS, and wherever Army Aviation is making history. Until the position of curator is filled, prospective donors are asked to communicate with the Museum Coordinator, Department of Maintenance Training, USAAVNS, Fort Rucker, Ala., 36360 (telephone extension 5600), before shipping items.

The position of museum curator (aeronautics), GS-11, at Fort Rucker has been announced by the Board of U. S. Civil Service Examiners. Persons interested in the job should file applications with the Executive Secretary, Board of U. S. Civil Service Examiners, U. S. Army Aviation Center, Fort Rucker, Ala., 36360.